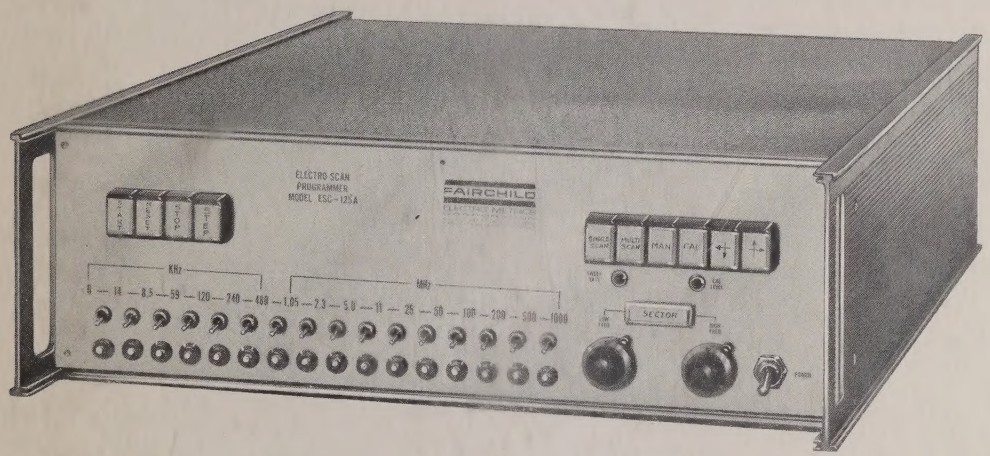
INSTRUCTION MANUAL

ELECTRO-SCAN PROGRAMMER



MODEL ESC-125A

FAIRCHILD
ELECTRO-METRICS
CORPORATION
A SUBSIDIARY OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION
AMSTERDAM, NEW YORK

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SECTION I
INTRODUCTION

1.1 THE MANUAL

This manual is intended for use by persons concerned with the operation, maintenance and repair of the ESC-125A Programmer.

1.2 THE ESC-125A PROGRAMMER

The ESC-125A Programmer is a special purpose computer which functions as an automatic command and control center for a pair of Interference Analyzers. The programmer is specifically designed to be a compatible accessory with Fairchild Electro-Metrics Interference Analyzers Model EMC-10 and EMC-25R, but may be easily adapted to other similar types of analyzers. The programmer will automatically control the selection and sweep of frequency bands in the range of 20 Hz to 1 GHz, and the plotting of the spectrum profile for any band (or portion of a band) in that frequency range on the X-Y plotter.

SECTION II
THEORY OF OPERATION

2.1 GENERAL

The ESC-125A Programmer is a special purpose computer designed specifically to control the operation of Fairchild Electro-Metrics Interference Analyzers and X-Y plotter. The programmer operator manually selects the frequency bands to be analyzed by operating toggle switches on the front panel of the programmer unit. The programmer compares this selected frequency band against the frequency band to which the analyzer is set. If the frequency bands disagree, the programmer commands the band-stepping mechanism in the analyzer to seek through its range until the bands agree. The programmer then generates a sweep voltage and synchronizes the rate of sweep between the X-Y plotter and the analyzer, and automatically positions the starting coordinates for the pen on the X-Y plotter for the frequency band being scanned. When the selected band has been swept, the programmer commands the analyzer to step to the next selected band. Special functions such as repeated scans of a selected frequency band, expanded scan of a selected frequency band, or expanded scan of a sector of a frequency band are selectable by operator-controlled pushbuttons on the front panel.

2.2 LOGIC

Logic circuitry throughout the programmer is composed of J-K flip-flops, inverters and NOR gates. The J-K flip-flops are used in the counter circuit. Decoding matrixes are composed of inverters and NOR gates.

Figure 2.1 shows the element pin numbers for the J-K flip-flop and their functions. In Table 2-1, the operating characteristics of the particular type of J-K flip-flop used in the programmer are stated in a truth table showing element pin numbers and input-output logic levels. The inputs applied at time n are responsible for the output level which occurs when a trigger is applied (time n + 1).

High inputs are represented by "1" and low inputs as "0". If both inputs are "1", no change will result when a trigger is applied. In this table, a "no change from previous state" condition is represented as X^n. If only the pin 3 input is a "1", the output at pin 7 will be a "0" at trigger time. If only the pin 1 input is a "1", the output will be a "1" at trigger time. Note however, that when both inputs are "0", the output state will be the inverse of its previous state ($\overline{X}^n$) at trigger time. The output at pin 5 will always be the opposite of the output at pin 7. Thus, there is a predictable output for every possible combination of inputs. When RESET occurs, pin 7 goes to "0" and pin 5 goes to "1".

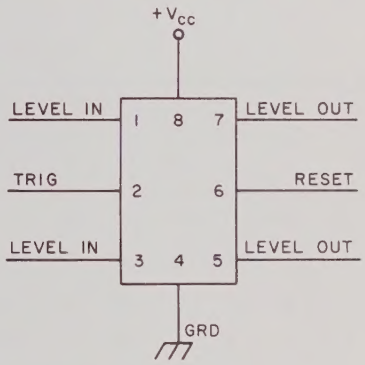


Figure 2.1 J-K Flip-Flop Input-Output

TABLE 2-1

J-K FLIP-FLOP TRUTH TABLE

INPUT T = N		OUTPUT T N + 1
PIN 1	PIN 3	PIN 7
1	1	X^n
0	1	0
1	0	1
0	0	$\overline{X}^n$

Table 2-2 shows the truth table for the NOR gate.

TABLE 2-2

NOR GATE TRUTH TABLE

INPUTS		OUTPUT
A	B	C
0	0	1
0	1	0
1	0	0
1	1	0

As shown in Table 2-2, the NOR gate output will be high (1) only when all inputs are low (0).

2.3 BLOCK DIAGRAM DISCUSSION (Figure 2.2)

2.3.1 COUNTER. The counter is composed of nine J-K flip-flops. Because of the unique switching characteristics of the J-K flip-flop, it is possible to set the counter to any state (or count) with the application of a single trigger pulse without having to cycle through all the other states. This is accomplished by shorting out selected stages in the counter, thus changing the number of active stages. Selector switches on the front panel which are associated with various frequency bands determine which of these stages are to be shorted out, thus determining the physical configuration of the counter. The state of the counter is represented in an eighteen-digit binary code, which is sent to the state detect matrix for decoding. Table 2-3 shows all the possible states at the outputs of the nine flip-flops in the counter.

TABLE 2-3

FLIP-FLOP STATES IN COUNTER

	FLIP-FLOP OUTPUT AT PIN 7									FLIP-FLOP OUTPUT AT PIN 5								
STATE	FF 1	FF 2	FF 3	FF 4	FF 5	FF 6	FF 7	FF 8	FF 9	FF 1	FF 2	FF 3	FF 4	FF 5	FF 6	FF 7	FF 8	FF 9
SX	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1
0	1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
1	1	1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
2	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
3	1	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1	1	1
4	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1	1
5	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1
6	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1	1
7	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1
SY	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
8	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
9	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
10	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
11	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0
12	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0
13	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0
14	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0
15	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0

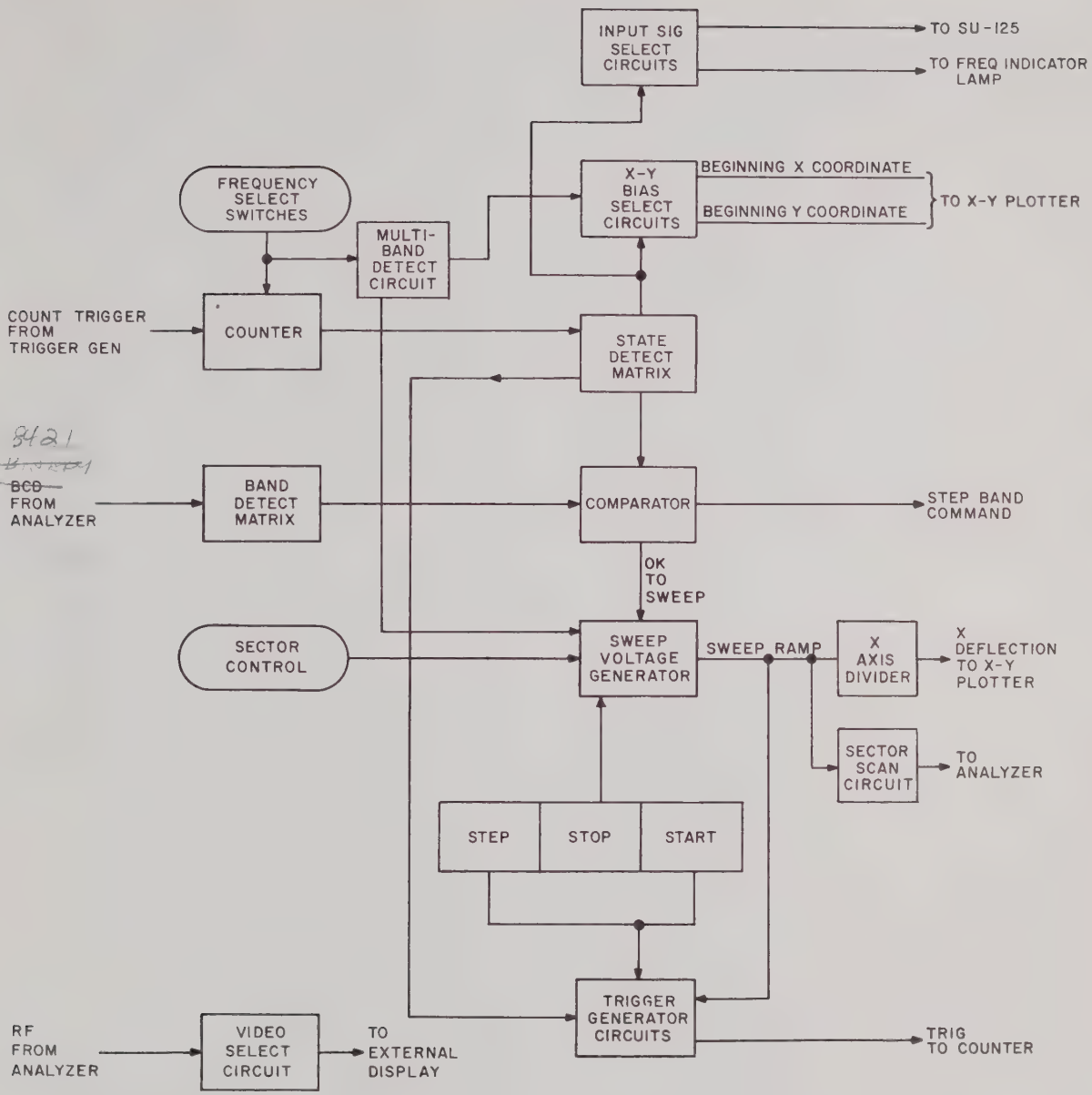


Figure 2.2 ESC-125A Programmer, Block Diagram

Figure 2.3 is a logic diagram for the counter showing all frequency bands selected by the switches. The output of each flip-flop is inverted and fed to the state detect matrix and also to a two-input NOR gate in the counter.

When a reset occurs, all flip-flops go to 0-1 on pins 7 and 5, respectively (state X). Note that the input connections to FF1 are reversed, unlike the inputs to all others. Since pin 7 goes to "0" and pin 5 goes to "1" at reset, connections from FF9 to FF1 must be reversed in order to provide a 1-0 input to FF1 and start the counter when a trigger is applied (Table 2-1). With the switches in the position shown, the NOR gates will act as inverters, since the only possible combinations of inputs is 0-0 or 1-1. Figure 2.4 is a simplified diagram showing the active flip-flops and the function of the frequency selector switch to set the counter to state 9, starting from reset. The counter will remain in the reset condition until the START button is depressed, to generate a count trigger. When a state has been selected which is numerically after state Y, the reset mode conditions all the FF's to be switched when the count trigger is applied. The counter will therefore completely invert its

output, so that the counter goes to state Y. This state automatically causes another count trigger to be generated, which because of the unique inputs to NOR gate G3, sets the counter output to state 9. Table 2-4 shows the states of the counter elements during the transistion from RESET to state 9.

This occurs as follows: FF1 will flip because its output during state Y was 1-0 and it will follow the 0-1 input applied from G17 and G18 at trigger time. FF2 will flip because its 0-0 input during state Y has conditioned it. FF3 however, will not flip, because its output during state Y was 1-0 and the input at trigger time is 1-0. Since it was already residing in the state for which it was conditioned, it remains as it was before the trigger. This is also true of all the following FF's in the counter. Note in Table 2-3 that state 9 is the only state in which pin 5 of FF2 is "1" at the same time as pin 7 of FF3 is "1". The gate in the state detect matrix which decodes state 9 is connected to these outputs.

2.3.2 STATE DETECT MATRIX. The state detect matrix is used to detect the frequency band chosen to be scanned by the programmer operator. Each of the frequency bands designated on the front panel of the programmer is associated with a preassigned eighteen-digit binary state code. This code is generated by the counter circuit. When the desired frequency band is selected at the programmer, the output of the counter contains its associated eighteen-digit binary code. The counter is so arranged that only one state of the counter will allow a particular set of contiguous flip-flops to produce opposite outputs at any one time (see Table 2-3).

The state detect matrix contains one gate for each possible state of the counter. Figure 2.5 is a simplified diagram showing how the state detect gates are connected to the flip-flop outputs in the counter. Note the difference in state detect matrix connections between FF9 and FF1, as compared to the connections between all other FF's. Whenever state Y is detected, a count trigger is sent to the counter to set it to the next selected frequency band, since the analyzer has no bands to which these codes correspond.

As shown in Table 2-3, state 9 is the only state in which pin 5 of FF2 and pin 7 of FF3 are at "1" simultaneously. This is the only code which will allow the gate for "detect state 9" to produce a "1".

The output from the active gate in the state detect matrix is delivered to the comparator, where it is compared with the analyzer band code from the band detect matrix. This output is also routed to the X-Y bias select circuits and to the input signal select circuits.

2.3.3 BAND DETECT MATRIX. The band detect matrix is used to detect the band to which the analyzer is set, and to deliver the band code to the comparator. Each frequency band within the range of the interference analyzers is associated with a preassigned four-digit binary code. The code for the particular frequency band to which the analyzer is set at any one time is delivered to the band detect matrix in the programmer. A specific gate within the matrix will decode this and only this code. The output from this gate is fed as a low "0" input to the comparator, where it is compared against the programmer "state" code. Figure 2-6 shows simplified logic for one of the detect gates in the band detect matrix. This illustrates the "detect band 10" gate, but the logic operation is the same for all others in this matrix.

2.3.4 COMPARATOR. The comparator contains one gate for each frequency band in the selectable range. These gates are fed by two levels; one, the output from the band detect matrix and the other the output from the state detect matrix. When the frequency band of the analyzer and the selected frequency band of the programmer are the same, the inputs to each gate in the comparator will be "1" and "0". The gate therefore will have a low "0" output and a band step command will not be issued to the analyzer. If the analyzer is not set to the frequency band selected at the programmer, the comparator will issue a high "1" output to the analyzer, commanding it to step frequency bands. This command will be repeated after each comparison, until the analyzer frequency band is in agreement with the programmer. Figure 2.7 illustrates the NOR gate logic in the comparator, showing the logic function when the comparator is set at frequency band 9 and the analyzer is set to frequency band 10. (Reference Table 2-3 for FF state codes.)

2.3.5 SWEEP CIRCUITS. The programmer sweep circuits feed a linear voltage ramp to the analyzer, which sweeps the analyzer from the low end to the high end of the band. This voltage may be generated within the sweep circuits, or by the tuning potentiometer on the analyzer. When the sweep circuits generate the voltage ramp, a low leakage charging capacitor is fed a constant current through a known resistor, resulting in a linear voltage charge, which is delivered through a unity gain amplifier to the analyzer as a sweep voltage.

When the analyzer is tuned manually, the charging capacitor network is disconnected. The position of the tuning potentiometer on the analyzer corresponds to a tuning voltage level. This voltage is fed directly back to the analyzer. The output voltage of the sweep circuit is compared with the tuning voltage in a difference amplifier

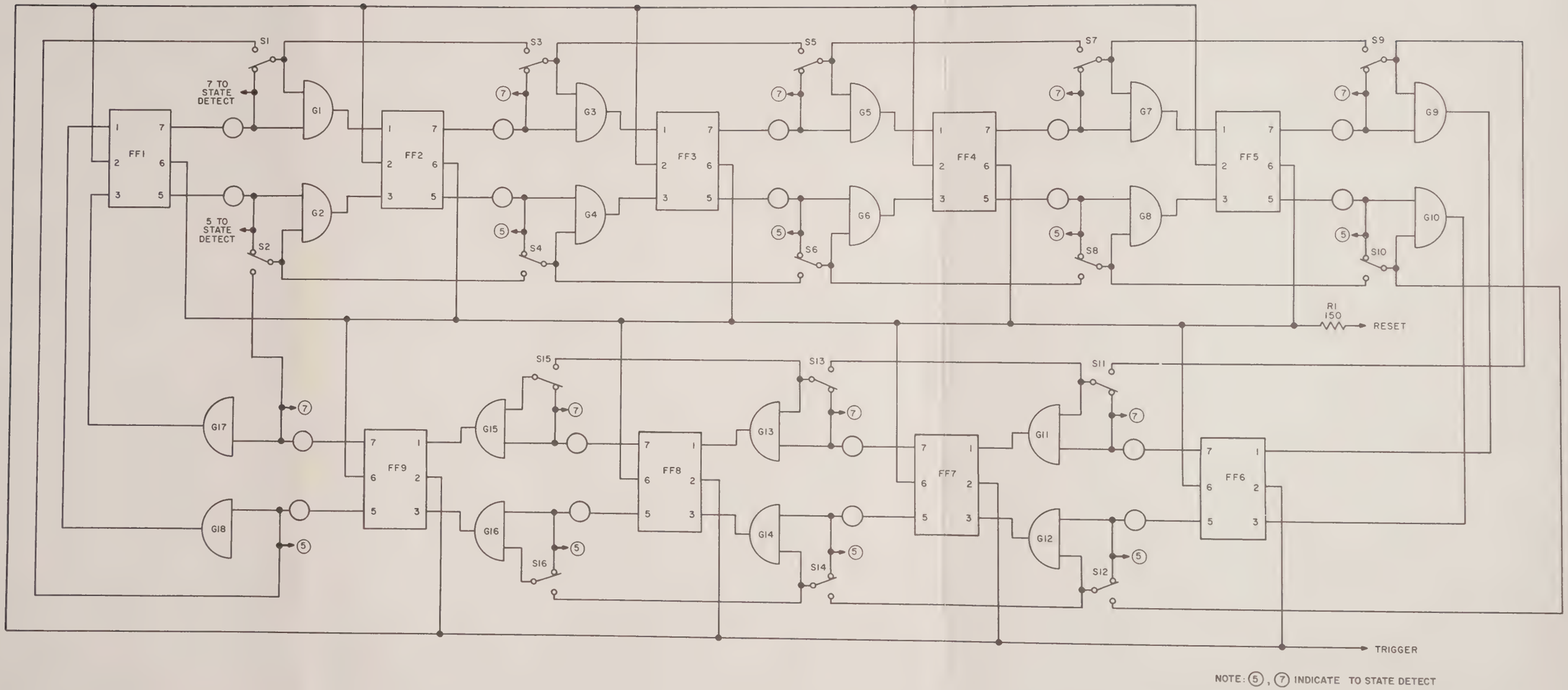


Figure 2.3 Programmer Counter, Logic Diagram

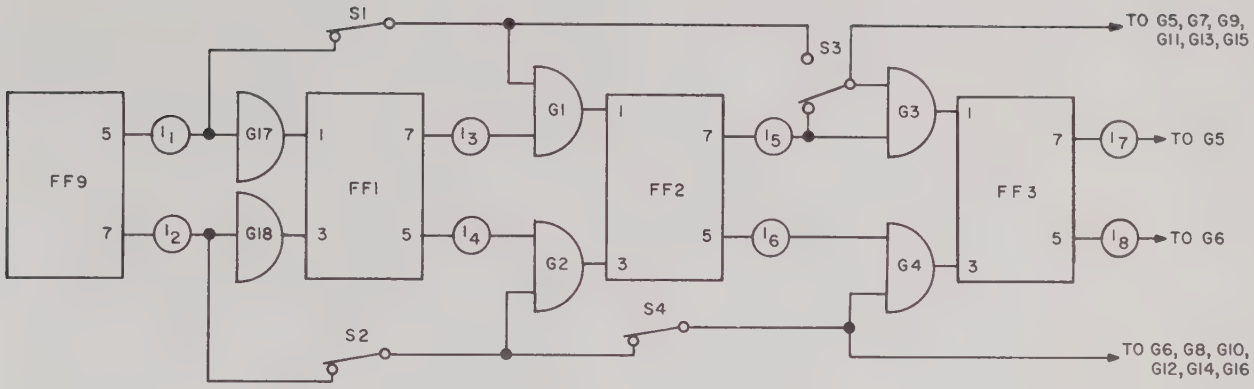


Figure 2.4 Counter Set, Simplified Diagram

TABLE 2-4

COUNTER STATES - FROM RESET TO STATE 9

	FF9						FF1						FF2						FF3	
	7	5	I_1	I_2	G17	G18	7	5	I_3	I_4	G1	G2	7	5	I_5	I_6	G3	G4	7	5
OUTPUT AT RESET	0	1	0	1	1	0	0	1	1	0	0	0	0	1	1	0	0	0	0	1
OUTPUT AT STATE Y	1	0	1	0	0	1	1	0	0	1	0	0	1	0	0	1	1	0	1	0
OUTPUT AT STATE 9	1	0					0	1					0	1					1	0

so that the X-Y plotter pen will be properly positioned with the frequency dial reading on the analyzer. A block diagram of the sweep circuits is shown in Figure 2.8. Component designations within the blocks refer to those shown in Figure 7.6, unless otherwise noted.

2.3.5.1 RAMP GENERATOR CIRCUIT. Amplifier A1 is a high input impedance, unity gain amplifier. This amplifier feeds the ramp rate control network, which supplies a feedback of a known fixed current to the charging capacitor connected to the input of the amplifier. This capacitor charges linearly from 0 VDC to 3.0 VDC, at a rate determined by the feedback current supplied by the control network. Unity gain amplifier A1 delivers this controlled ramp voltage to the sector scan circuits, to the sector scan bypass circuits, to the X coordinate position circuits and to the trigger generator circuits.

2.3.5.1.1 RAMP RATE CONTROL NETWORK. The ramp rate control network contains a voltage divider network which provides a 4:1 difference in the feedback current to the charging capacitor in the ramp generation circuit. This divider is keyed out of the feedback loop by the single/multi-band detect circuit, which senses whether more than one frequency band is selected to be scanned. If only one band is selected to be scanned, the 4:1 divider circuit increases the charging time of the capacitor by 4, to permit the X deflection rate on the X-Y plotter to remain constant for both multi and single band scans. A RAMP RATE control potentiometer on the front panel allows the rate of generation of the ramp voltage to be adjusted so that the scan time may be set to sweep all 16 bands in less than two minutes (at a rate of about 10 seconds per band) or in as long as four hours (15 minutes per band) on multi-band plotting paper. Scan rate for single band is adjustable from 40 seconds to one hour.

2.3.5.2 SECTOR SCAN CIRCUITS. The sector scan circuits select the upper and lower voltage levels of the ramp to be applied to the analyzer. (See Figure 2.9.)

This is accomplished by feeding one ramp output from difference amplifier A1 into an inverter amplifier, and providing the inverted ramp with a new DC reference level. The

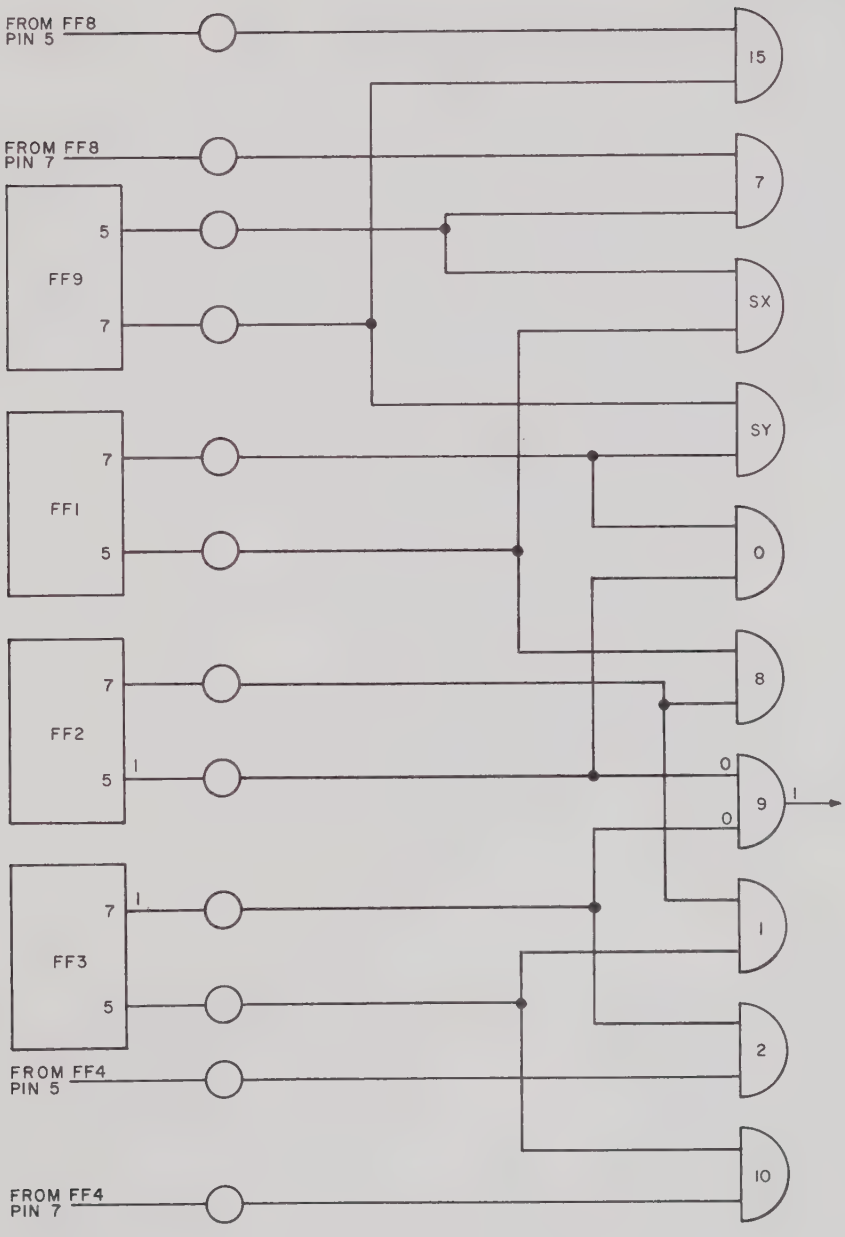


Figure 2.5 State Detect Matrix, Simplified Diagram

other ramp output from the difference amplifier is not inverted. The two ramp voltages are then fed through high and low sector scan pots, which select the high and low voltage levels of the ramp. A summing network combines the opposing ramp levels and delivers the adjusted ramp to a differential amplifier.

Sector scan may be used only when not more than a single band has been selected. When more than a single band is selected, sector scan is automatically bypassed and the uninverted ramp from difference amplifier A1 is delivered through the sector scan bypass circuit directly to difference amplifier A2. This is controlled by the multi/single band detect circuit.

2.3.5.3 MULTI-BAND DETECT CIRCUIT. The bias board contains a transistor switching circuit which detects whether more than one frequency band has been selected by the switches on the front panel. When more than one band has been selected, this circuit will key the ramp rate control network to bypass the 4:1 voltage divider network and to permit the ramp to be

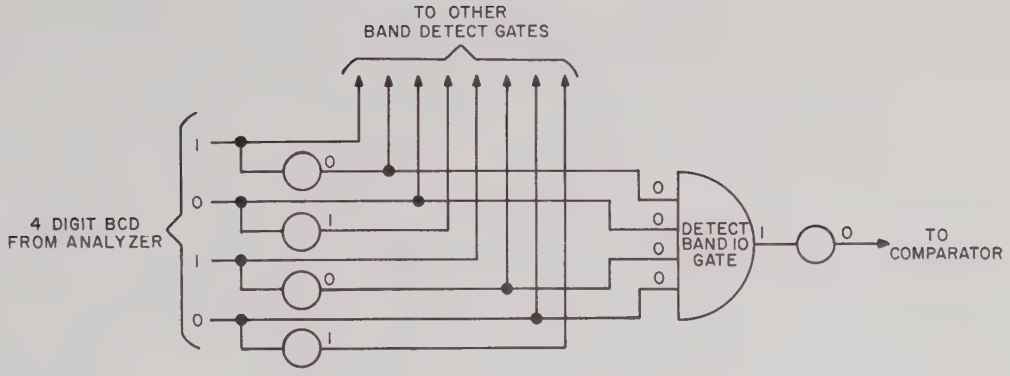


Figure 2.6 Band Detect, Simplified Logic

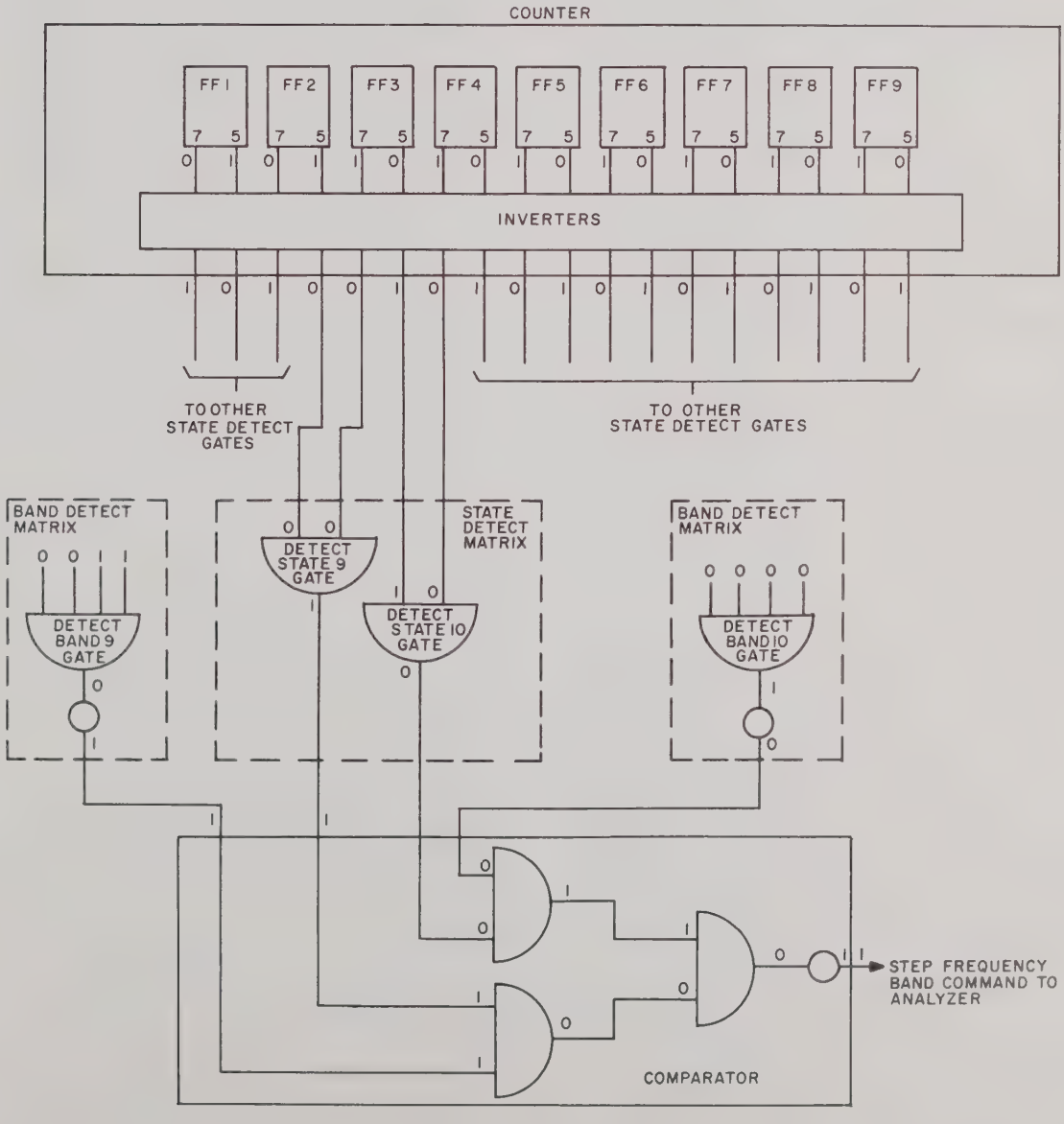


Figure 2.7 Step Band Command Logic, Simplified Diagram

generated in one-quarter the time allotted during single-band scanning. This circuit also keys the X-axis sweep divider circuit and the Y axis deflection divider circuit, to affect a 4:1 reduction in X-Y travel and keep the scan profile within its allotted chart space. The X-Y bias network is also keyed by this circuit, to make the biasing network gates active.

2.3.5.4 SWEEP INHIBIT CIRCUIT. A STOP command from the front panel pushbutton, detection of state X, or a STEP command from the comparator will cause the sweep inhibit circuit to be active. This causes the ramp generator to be disabled by shorting out the charging capacitor, so that no sweep can be generated. The relay which causes the pen to be dropped on the chart in the X-Y plotter is also disabled. The reason for this during STOP is evident. During a STEP command, the circuit provides a means for temporarily disabling the generation of a sweep voltage while the analyzer is stepping to seek the selected frequency band. When state X is detected, it means that the highest selected frequency band has been swept. If the programmer is in multi-scan mode and only one frequency band has been selected, the counter passes through state X before it sets itself to the selected frequency band. State X therefore causes the ramp generator to be disabled and the pen to be lifted from the graph paper for reset.

2.3.5.5 DELAY NETWORK. The 0.3-second delay network allows time for the pen positioning circuits to properly align the pen on the X coordinate before dropping it on the chart. The ramp generator circuits are then enabled.

2.3.5.6 X-AXIS SWEEP DIVIDER CIRCUIT. When only a single band is selected, the X-Y plotter will use the entire area of the chart paper to plot the frequency profile. Therefore, a special full page chart is used. When more than one band is to be scanned, the chart paper is as shown in Figure 2.10. The sweep distance traveled across the chart is directly proportional to the ramp voltage applied. When more than one of the frequency select switches on the front panel are selected, the multi-band detect circuit commands the X-axis sweep divider circuit to route the ramp voltage from difference amplifier A1 through a 4:1 divider network before delivering the voltage to the X-Y plotter, to keep the scan profile within its allotted chart space. When only one frequency band is to be plotted, the 4:1 divider is bypassed and the full ramp voltage is allowed to pass to the plotter.

2.3.5.7 Y-AXIS DEFLECTION DIVIDER CIRCUIT. The Y-axis deflection voltage from the EMC-25R or the EMC-10 is routed through the Y-axis deflection divider circuit before being delivered to the X-Y plotter. When more than one frequency band has been selected to be scanned, the multi-band detect network commands the divider circuit to cause a 4:1 reduction in the deflection voltage from the analyzer before delivering it to the X-Y plotter, in order to keep the scan profile within its allotted chart space. When only one frequency band is to be plotted, the 4:1 divider is bypassed and the full deflection voltage is allowed to pass to the plotter.

2.3.6 MANUAL SWEEP SYNC CIRCUITS. When the programmer is in MANUAL mode, the charging capacitor network is disconnected from the sweep circuit. The programmer operator will normally select MANUAL mode when it is desired to analyze only a certain point within the band. As the analyzer is manually tuned through the band, a voltage which is continually proportional to the amount of tuner potentiometer rotation is generated. This voltage is fed through the manual sweep sync circuits to amplifier A1 of the sweep circuits, where it is amplified and fed to the X-axis sweep divider circuit. Thus, the pen of the X-Y plotter is positioned to the point on the chart corresponding to the analyzer dial setting.

Amplifiers A1, A2 and the sweep sync circuit form a closed loop. A difference amplifier in the sweep sync circuit senses any difference in the voltage from the analyzer and the voltage from the output of amplifier A2, and feeds this difference back as an input to amplifier A1. This forces the output at A1 to the X-axis sweep divider circuit to follow the voltage output at the tuning pot of the analyzer, resulting in synchronization of the pen travel to the analyzer tuner.

2.3.7 X-Y BIAS NETWORK. The X-Y bias network sets the starting coordinates of the X-Y plotter for each frequency band. The multi-band chart paper contains 16 charts (Figure 2.10). The charts, as numbered in the figure, coincide with the states (bands) as defined in Table 2-3.

As can be seen from Figure 2.10, the X coordinate starting point is the same for each group of four bands (i.e., 8, 9, 10, 11), and each Y coordinate starting point is the same for each group of four bands (i.e., 1, 5, 9, 13).

The bias circuit consists of voltage divider networks which divide the X and Y bias voltages a predetermined amount, to position the pen to the correct chart location on the multi-band paper (see Figure 2.11). State information from the state detect matrix is delivered to gates in the bias network, which select the correct X-Y bias network to place the pen to the lower left-hand corner of the prescribed chart. States 0, 1, 2 and 3 do not affect the Y bias network, since there is full Y deflection on the pen to fix the Y coordinate for these charts. States 3, 7, 11 and 15 do not affect the X bias network. Calibration

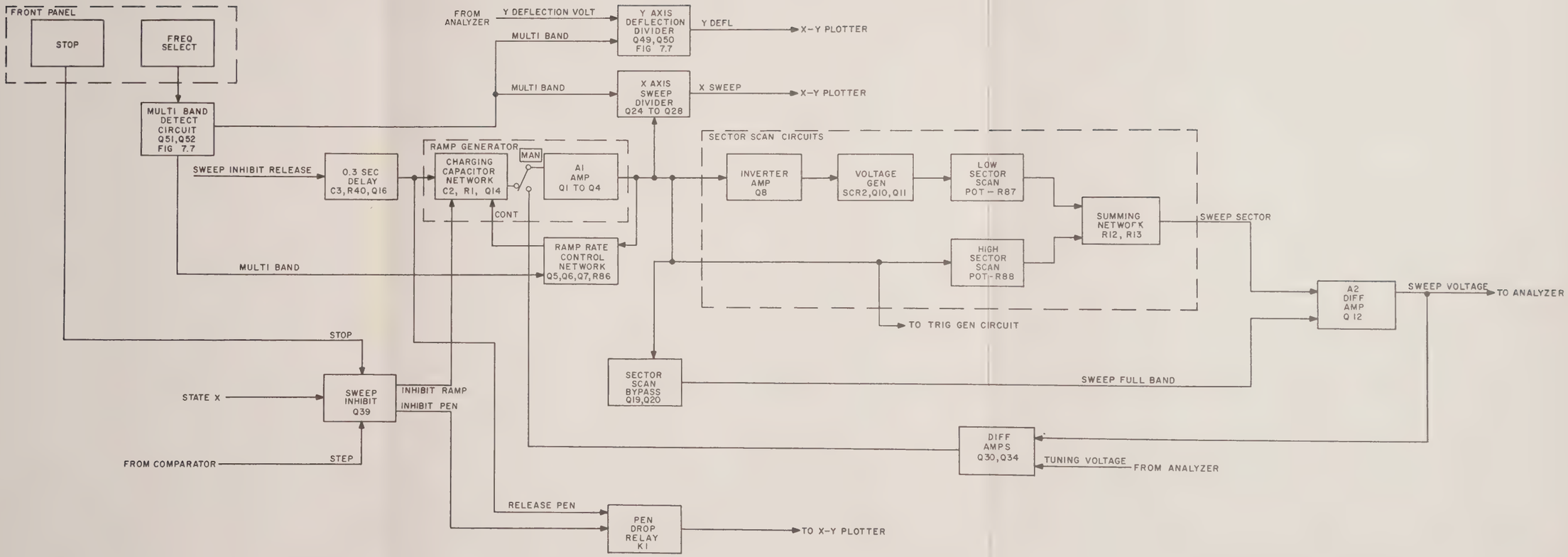


Figure 2.8 Sweep Circuits, Block Diagram

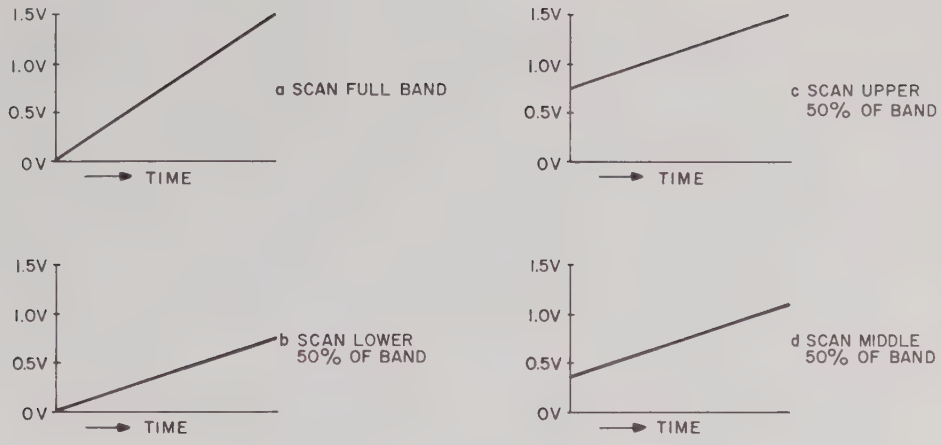


Figure 2.9 Sector Scan Ramp Representation

switch marked ⊣+ will place the pen at the start point for chart 12. As can be seen from Figure 2.11, both of these levels pass through the same gates, to bias the X axis 100% and to bias the Y axis 100%. The start point on the chart for band 3 is a natural state of the bias network. That is, if the programmer is in STOP, RESET or state X, the pen of the plotter will rest at this point.

2.3.8 INPUT SIGNAL SELECT CIRCUITS. The input signal select circuits contain a separate transistor pair connected to the output of each detect gate within the state detect matrix. An output from the associated state detect gate (indicating the counter to be in that state) causes one transistor of the transistor pair to light a front panel indicator lamp designating the frequency band selected. The other transistor controls the operation of a coaxial relay in the input signal switching unit, to select the proper input signal connector.

2.3.9 TRIGGER GENERATOR CIRCUITS (Figure 2.12). The trigger generator circuits are keyed by either internal detection circuits or by pushbuttons located on the front panel, to provide a trigger pulse which causes the counter to advance to the next selected frequency band.

The ADVANCE pushbutton will cause a trigger to be immediately generated and the counter to advance to its next selected state. The MULTI-SCAN pushbutton allows a trigger to be generated after the last selected frequency band has been scanned, to allow recycling of the selected bands. The START pushbutton causes a trigger to be generated when the counter is in state X, to allow the counter to advance to the first selected state. When state X is not present, the START pushbutton only permits the programmer to continue through whatever function had been interrupted.

When the state detect matrix decodes state Y in the counter, a trigger is generated to set the counter to the next selected state, since the analyzers contain no band to correspond to state Y.

An "end of sweep" trigger is generated by a voltage comparator network which receives the ramp voltage from the sweep circuits and compares it against a preset reference voltage. When the ramp voltage reaches a certain level (indicating end of sweep) the voltage comparator keys the trigger generator, to allow the counter to advance to the next selected state.

2.3.10 VIDEO SELECT CIRCUIT. The video select circuit is a special application switching network which receives the video signal from either the EMC-25R or the EMC-10 and routes the signal to an auxiliary output connector. The switching network is controlled by two gates on the bias board, which are fed by the state detect matrix. When state "0" is detected, the video signal from the EMC-10 is allowed to pass to the output connector. Detection of any other state except state X or state Y allows the EMC-25R video signal to pass to the output connector.

2.3.11 STATUS CONTROL LOGIC. The status control gates sense the condition of the front panel switches and affect the programmer operation. Manual switches for POWER, START, STOP, SINGLE SCAN and RESET are routed through this circuit, as well as the internally generated condition, state X.

When the POWER switch is set to ON, a time delay network permits a STOP condition to be routed to the sweep circuits and a RESET to be routed through the gates to the counter before operating power is applied to the START circuit.

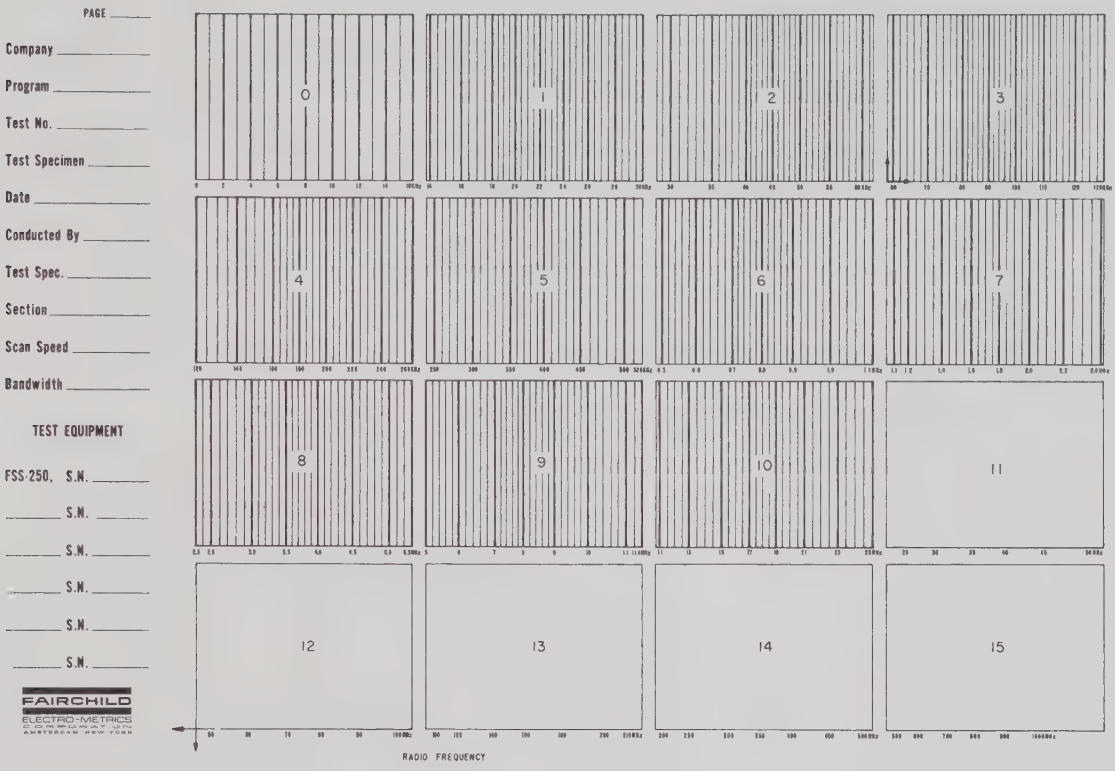


Figure 2.10 Multi-Band Chart Paper Layout

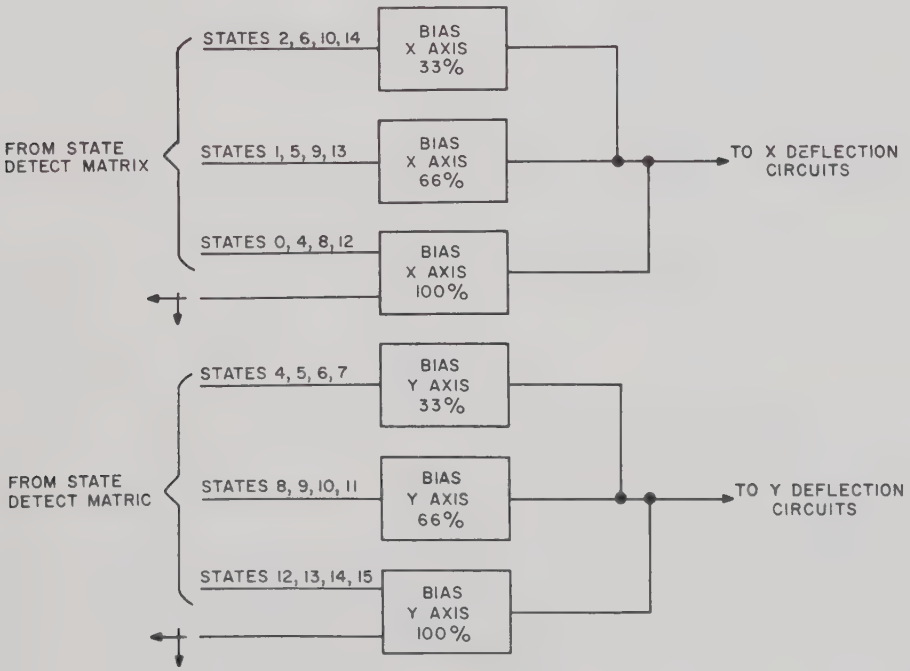

STATES 2, 6, 10, 14
BIAS X AXIS 33%
FROM STATE DETECT MATRIX
STATES 1, 5, 9, 13
BIAS X AXIS 66%
TO X DEFLECTION CIRCUITS
STATES 0, 4, 8, 12
BIAS X AXIS 100%
STATES 4, 5, 6, 7
BIAS Y AXIS 33%
FROM STATE DETECT MATRIC
STATES 8, 9, 10, 11
BIAS Y AXIS 66%
TO Y DEFLECTION CIRCUITS
STATES 12, 13, 14, 15
BIAS Y AXIS 100%

Figure 2.11 X-Y Bias Network, Simplified Diagram

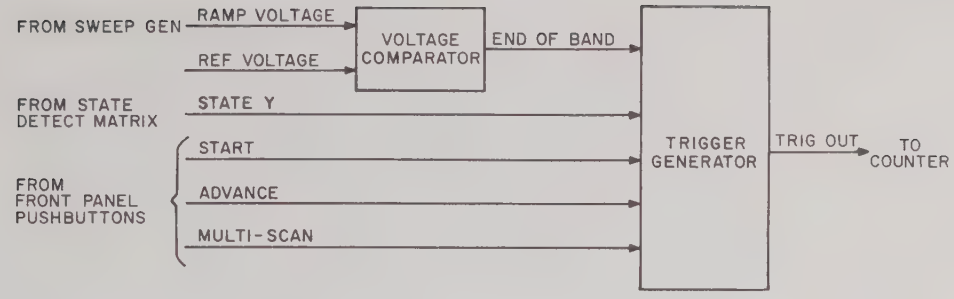


Figure 2.12 Trigger Generator Keying

These gates also sense state X when the START pushbutton is depressed. If state X is present, a count trigger will be generated to switch the counter out of state X and into the lowest selected frequency band. If the MULTI-SCAN pushbutton has been depressed, the gates will allow the counter to begin recycling when state X is reached. If the SINGLE SCAN pushbutton has been depressed, the gates will cause a STOP condition when state X is reached.

2.3.12 POWER SUPPLY AND POWER SUPPLY REGULATOR (Figures 7.10 and 7.11). The power supply produces six voltages; +24 VDC unregulated, +140 VDC unregulated, +12 VDC regulated, +3.6 VDC regulated, -12 VDC regulated and +300 VDC regulated. A line selector switch on the rear panel sets the input transformer for a 110 VAC, 60 Hz input or a 220 VAC 60 Hz input.

Terminals 5 and 6 of transformer T1 supplies a full-wave rectifier consisting of CR1 through CR4. Rectified +24 volts out of the full-wave rectifier is utilized to power the difference amplifier Q1 in the regulator, as well as being routed to other 24 VDC requirements in the system. This output is also connected to the collector of voltage regulator transistor Q6. The output at the emitter of Q6 is adjusted to +12 volts by potentiometer R4. This output is fed to pin 3 of difference amplifier Q1. The output of the emitter of Q6 is also fed to transistor Q2, which is connected to act as a zener diode and provides a reference voltage into pin 2 of Q1. The difference amplifier compares the reference voltage across zener Q2 to the output of regulator transistor Q6. Any difference voltage is amplified and sent as a bias voltage to control the output of Q6. The voltage is thus regulated to +12 VDC.

The regulated +12 VDC from the emitter of Q6 is also fed to a voltage divider consisting of R7, R8 and R9. The input to pin 3 of Q3 is adjusted to 3.6 VDC by potentiometer R8, as a reference voltage. The 3.6-volt output from transformer T1 is taken from pins 7 and 8. A full-wave rectifier consisting of CR9 through CR12 feeds the +3.6 VDC through Q9 to pin 2 of Q3.

The difference voltage developed in Q3 is fed as a bias voltage to regulator transistor Q7, which controls current drivers Q8 and Q9. Thus the 3.6 VDC is regulated.

The -12-volt regulator is supplied from terminals 9 and 10 of transformer T1 through rectifiers CR5 to CR8. Difference amplifier Q5 controls the -12 VDC output of regulator transistor Q10.

The secondary of transformer T2 supplies a voltage tripler consisting of diodes CR9, CR10, CR11, and capacitors C18, C19 and C20 which delivers +400 volts to the neon bulb shunt regulators, to produce +300 VDC regulated. The +140 VDC unregulated is produced at the junction of C19 and C20.

SECTION III
OPERATING INSTRUCTIONS

3.1 GENERAL

This section provides instructions for complete operation and pre-operating calibration of the ESC-125A.

3.2 UNPACKAGING

3.2.1 Remove the instrument carefully from the shipping carton and examine thoroughly for any sign of shipping damage. If there is evidence of damage, replace the instrument in the shipping carton and immediately inform the manufacturer and the shipping company of the nature of the damage, the serial number of the instrument, the delivery date, and the invoice number.

3.2.2 Check contents of the carton against shipping slip to ascertain that all components and accessory items ordered are present. Notify the manufacturer immediately of any missing items.

3.3 ELECTRONIC SHIPPING DAMAGE

This instrument was subjected to a complete operational check before leaving the factory. However, it is possible that electronic damage may have occurred in transit. Therefore, check the operation of the instrument immediately after unpackaging.

3.4 POWER REQUIREMENTS

Unless otherwise specified on the purchase order, the ESC-125A is normally wired for operation with either a 105-130 volt AC line power supply or a 210-260 volt AC line power supply. There is a switch on the rear panel to select between these two line voltages. This switch should be checked before operating the instrument to insure that it is in the correct position for the voltage being used. Severe damage to the programmer will result if the switch is in the wrong position. When using line power in the 105-130 volt range, a one amp slo-blow fuse is used. When using line power in the 210-260 volt range, a 1/2 amp slo-blow fuse is used.

3.5 INSTALLATION

3.5.1 The ESC-125A is designed for bench-top operation or for installation in a conventional 19-inch equipment rack.

3.5.2 Rack mounting requires the use of two adapter mounting brackets (ABA-125) which are provided. Using these brackets, install the instrument by the following procedure:

a) Using four 3/8-inch No. 8-32 screws, fasten brackets to sides of instrument at matching screw holes.
b) Before installing in equipment rack, provide sufficient support for the instrument.

3.5.3 The input signal switching unit should be programmed according to instructions given in Section V of this manual.

3.5.4 Connect inter-unit cables and power cable as marked on the unit chassis (Figure 5.4). Check that the LINE switch on the rear panel is set to the power source voltage being used.

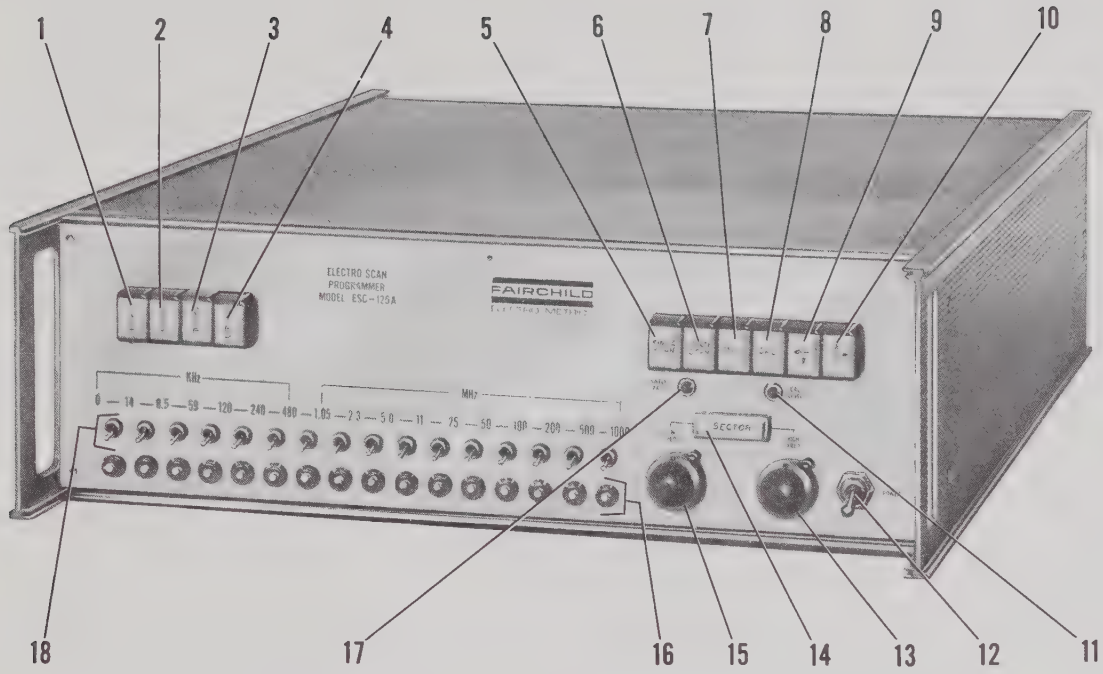
3.5.5 If the programmer is to be used for the first time with an EMC-10 or an EMC-25R, the units must be calibrated and aligned (see paragraph 3.9). Each time the alignment procedures described in paragraph 3.9 are performed, it is necessary to perform the Pre-Operational Calibration procedures as listed in paragraph 3.10.

3.6 FRONT PANEL CONTROLS

3.6.1 Most normal operating controls for the ESC-125A are located on the front panel. These controls are illustrated in Figure 3.1 and described below.

3.6.2 POWER SWITCH. The power switch delivers the line power and places the programmer in the STOP and RESET modes initially. The STOP mode prevents the programmer from sweeping during initial turn-on.

3.6.3 FREQUENCY BAND SELECTION SWITCHES. The frequency band selector switches select the frequency band or bands to



1. START Pushbutton
2. RESET Pushbutton
3. STOP Pushbutton
4. STEP Pushbutton
5. SINGLE-SCAN Pushbutton
6. MULTI-SCAN Pushbutton
7. MANUAL Pushbutton
8. CALIBRATE Pushbutton
9. ←┼ Pushbutton
10. ┼→ Pushbutton
11. CALIBRATION Level Adjust
12. POWER Switch
13. HIGH FREQUENCY Sector Adjust
14. SECTOR Light
15. LOW FREQUENCY Sector Adjust
16. Frequency Band Indicator Lamps (16)
17. SWEEP RATE Adjust
18. Frequency Band Selector Switches (16)

Figure 3.1 Front Panel Controls

be swept by the analyzer. The toggle switches of the frequency bands to be swept are placed in the UP position. The frequency band range is marked over each switch. An indicator light under the switch will illuminate when the programmer is sweeping that particular band. Any or all of the selector switches may be placed in the UP position to allow frequency bands to be sequentially swept.

3.6.4 SECTOR SCAN CONTROLS. The sector scan controls allow any portion of a frequency band to be scanned. Percentage of the band to be swept is controlled by potentiometers on the front panel. One potentiometer dial is marked HIGH FREQ to select the high frequency limit of the scan, and the other is marked LOW FREQ to select the low frequency limit of the scan. The potentiometers are calibrated so that their dial numbers correspond to a percentage of the particular frequency band. Sector scan will operate only when one frequency band is selected. The SECTOR indicator lamp illuminates when the unit is in sector scan mode. The portion of the band being scanned will be expanded over the entire graph paper.

3.6.5 START SWITCH. The START switch, when depressed, releases the stop and reset modes, and starts the sweeping operation of the selected frequency bands. The start mode is released by depressing the STOP or RESET buttons. The programmer remains in the start mode while scanning operations are performed.

3.6.6 STOP SWITCH. The STOP switch, when depressed, overrides the START mode and brings the programmer operation to a stop.

3.6.7 RESET SWITCH. The RESET switch, when depressed, overrides the START mode and initiates the STOP mode. RESET sets the programmer state to the lowest frequency band selected. When the START switch is depressed, the programmer will then begin sweeping from the lowest selected frequency band.

3.6.8 STEP SWITCH. The STEP switch will sequentially advance the counter one state each time it is actuated. It also initiates the START mode and releases the STOP and RESET.

3.6.9 CALIBRATION SWITCHES. There are three calibration switches. The one marked ↑→ will move the pen of the X-Y plotter to the upper right hand chart of the paper when depressed. Adjustment of the X-Y plotter gain is then made to set the pen in the correct position.

The calibration switch marked ←↓ will move the pen of the X-Y plotter to the lower left chart of the paper. The zero control of the plotter may then be set. Both switches cannot be depressed simultaneously.

The third switch, marked CAL, is used to operate the impulse generator of the EMC-25R and place the programmer in the SINGLE SCAN mode. This is used to calibrate the EMC-25R. When calibrating the EMC-25R, the frequency bands to which it is being calibrated are selected with the FREQUENCY SELECTOR switches of the ESC-125A.

3.6.10 SINGLE-SCAN CONTROL. The SINGLE-SCAN switch, when depressed, will cause the programmer to scan through the selected frequency bands once and stop.

3.6.11 MULTI-SCAN CONTROL. The MULTI-SCAN switch, when depressed, will allow the programmer to re-cycle after the last selected frequency band has been swept, in order to scan again the selected bands. The programmer will continue re-cycling through the bands until the STOP or the RESET switch is depressed.

3.6.12 MANUAL SWITCH. The MANUAL switch, when depressed, disconnects the programmer ramp generator from the analyzer, so that the analyzer may be tuned manually. The operator will normally select the MANUAL mode when it is desired to examine a particular frequency point within a band. The analyzer is manually tuned to the desired frequency as read on the tuning dial. The pen of the X-Y plotter will follow so that it is located at the correct point on the band chart. The pen will not scan, but only record the profile of the frequency at that point.

When in the MANUAL mode, the sector scan controls should be set to their extremes, i.e., the LOW FREQ dial should be set to 0.0 and the HIGH FREQ dial set to 10.0. The MANUAL mode may be selected during either single-band or multi-band operation.

3.7 REAR PANEL

All connectors for external instruments are located on the rear panel. The line selector switch, a fuse, an auxiliary AC outlet and two power supply transistors are also located on the rear panel. These components are illustrated in Figure 3.2 and described below.

3.7.1 CONNECTORS

3.7.1.1 EMC-25R CONNECTOR. The EMC-25R connector is a multi-pin connector through which all the control voltages to and from the EMC-25R analyzer are routed.

3.7.1.2 EMC-10 CONNECTOR. The EMC-10 connector is a multi-pin connector through which all the control voltages to and from the EMC-10 are routed.

3.7.1.3 X-Y PLOTTER CONNECTOR. The X-Y PLOTTER connector is a multi-pin connector through which the X and Y voltages to control the placement and travel of the pen and also the control voltage to lift and lower the pen are routed.

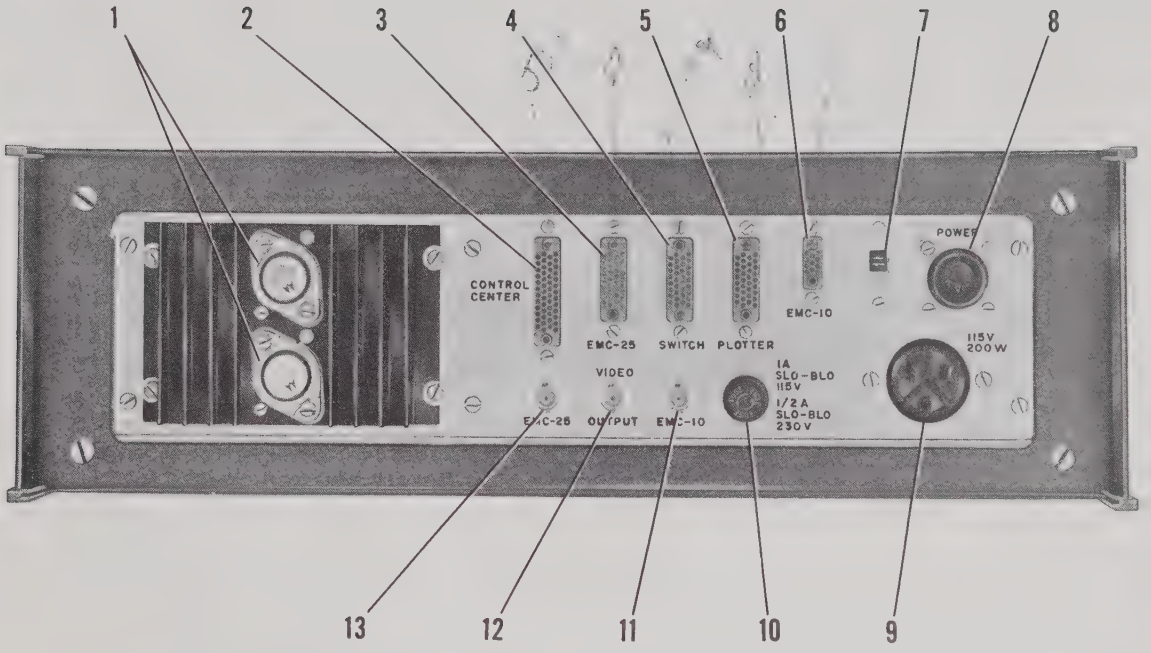
3.7.1.4 INPUT SIGNAL SWITCHING UNIT CONNECTOR. The INPUT SIGNAL SWITCHING UNIT connector is a multi-pin connector through which the programmer state information to operate the coaxial relays in the input signal switching unit, and the power supply voltages necessary to operate the coaxial relays and the antenna band switching motors are routed.

3.7.1.5 POWER LINE CONNECTOR. The POWER LINE connector is used to connect either 105-130 volt AC or 210-260 volt AC line power supply to the programmer.

3.7.1.6 BNC CONNECTORS. There are three BNC connectors on the rear panel of the ESC-125A. These may be used to route the video outputs of the interference analyzers to an external display. One connector provides the display input. The other two connectors accept the video outputs of the two interference analyzers. The ESC-125A selects the interference analyzer applicable to the band to be swept.

3.7.1.7 CONTROL CENTER CONNECTOR. The CONTROL CENTER connector is a multi-pin connector which delivers all the control voltages necessary when the ESC-125A is used in Electro-Metrics' spectrum surveillance system FSS-250. When the ESC-125A is not used in the FSS-250, a dummy plug will be supplied for the connector and should be in place at all times in order to operate the ESC-125A.

3.7.2 LINE SWITCH. The LINE switch is used to switch between 105-130 volts AC or 210-260 volts AC, depending on which power source is being used. This switch must be in the position



1. Power Supply Transistors Q8 and Q9
2. Connector, Control Center
3. Connector, EMC-25R
4. Connector, Input Signal Switching Unit
5. Connector, X-Y Plotter
6. Connector, EMC-10
7. Switch, Line Selector
8. Connector, Power Input
9. Connector, 110 VAC, Auxiliary
10. Fuse, Line
11. Connector, EMC-10 Video Input
12. Connector, Video Output
13. Connector, EMC-25R Video Input

Figure 3.2 Rear Panel Components

corresponding to the power source being used or serious damage to the ESC-125A will result.

3.7.3 FUSE. The fuseholder for the power line fuse is located on the rear panel. When line power in the 105-130 volt range is being used, install a one-amp slo-blow fuse. When line power in the 210-260 volt range is being used, install a 1/2 amp slo-blow fuse in the fuseholder.

3.8 GENERAL OPERATING PROCEDURES

The general operating procedure is as follows: Turn on all POWER switches. The STOP and RESET pushbuttons will illuminate. Insert a sheet of pre-calibrated multi-band paper in the X-Y plotter.

1. Normalize the X-Y plotter.
2. Check chart paper frequency calibration.
3. Check chart paper amplitude calibration.

3.8.1 NORMALIZING X-Y PLOTTER. Normalize the X-Y plotter by first depressing the pushbutton marked ←┼↓ . When this pushbutton is depressed, its indicator lamp will illuminate and the pen will move to the lower left corner of the band 12 chart on the paper. Adjust the X and Y zero controls of the X-Y plotter to position the pen exactly at the start point of this chart. Next, depress the pushbutton marked ↑┼→ on the programmer. When this pushbutton is depressed, its indicator lamp will illuminate and the pen will move to the start point of the band 3 chart on the paper. Adjust the X and Y gain controls of the X-Y plotter to position the pen exactly. Repeat until no further adjustment is needed.

3.8.2 CHART PAPER FREQUENCY CHECK. Depress the MANUAL and STOP pushbuttons. Manually tune the analyzer across each band. Frequency sector marks on the paper should agree with the dial readings.

3.8.3 AMPLITUDE CHECK - EMC-10. Depress the MANUAL and STOP pushbuttons. Select the

EMC-10 frequency band at the programmer. Set the EMC-10 controls for amplitude calibration as described in its instruction manual. Manually tune the analyzer through the frequency band to see if the pen agrees with the precalibrated line. If the pen does not agree, adjust the CAL control on the EMC-10 analyzer.

3.8.4 AMPLITUDE CHECK - EMC-25R. Select all bands except band 0 at the programmer. Set the SWEEP RATE control on the front panel to maximum sweep rate. Depress SINGLE SCAN pushbutton. Select a level on Fairchild Electro-Metrics Model CLC-25 Calibration Level Control or an external impulse generator, which corresponds to a mid-range value on all bands. Depress the START pushbutton and allow the analyzer to scan. If the pen disagrees with the calibrated marks by the same amount on all bands, adjust the CAL control on the EMC-25R analyzer as required.

3.8.5 OPERATION. The ESC-125A is now prepared to begin operation. Select the desired frequency bands and insert the proper chart paper in the X-Y plotter.

If the programmer is in the SINGLE SCAN mode, it will go to the STOP mode when the scanning of the last selected frequency band has been completed. If the programmer is in the MULTI-SCAN mode, it will continue scanning all the selected frequency bands until either the STOP or RESET buttons have been pressed.

If it is desired to scan only a portion of a frequency band, set the HIGH FREQ and LOW FREQ pots of the SECTOR-SCAN controls to the desired high and low frequency limits. During SECTOR SCAN, only one frequency band may be selected. The SECTOR lamp indicates that the ESC-125A is in the SECTOR-SCAN mode.

The ESC-125A is now conditioned to begin scanning the selected frequency bands. Press the START button. The START indicator lamp should illuminate and the STOP and RESET indicator lamps be extinguished. The ESC-125A will now scan the selected frequency bands and the X-Y plotter will plot the spectrum. A lamp under the FREQUENCY SELECTION switch corresponding to the frequency band being swept will light to identify the frequency band being swept.

If it is desired to re-scan the particular band that is being scanned, depress the STOP button and then the START button. This action will start the scanning at the beginning of the band interrupted. If it is desired to go back to the lowest frequency band selected, depress the RESET button and then the START button.

The input signal switching unit is required for calibration of the interference analyzers. To calibrate the EMC-25R, connect the impulse generator output of the EMC-25R to the proper connector on the input signal switching unit (see Section V, Accessory Data). Connect the EMC-25R RF output at the input signal switching unit to the input connector of the EMC-25R. Set up the ESC-125A programmer for normal operation, as described above. Select the frequency bands to be calibrated. Depress the CAL button then the START button and the analyzer will begin scanning.

To calibrate the EMC-10, connect its CAL signal output to the proper connector on the input signal switching unit. Connect the EMC-10 RF output at the signal switching unit to the input connector of the EMC-10. Select the frequency band corresponding to the EMC-10. Depress the CAL button and the START button and the analyzer will begin scanning.

Refer to EMC-10 and EMC-25R instruction manuals for additional information on these units.

3.9 ALIGNMENT PROCEDURE

This procedure is to be performed if the ESC-125A programmer is to be used for the first time with a particular analyzer. If the programmer and analyzer were shipped together from the factory, this alignment procedure has already been performed.

Connect the analyzers and X-Y plotter to the programmer. Allow a 30-minute warmup time before proceeding with alignment. Place the multi-band chart paper in the X-Y recorder and calibrate the pen as described in paragraph 3.8. Set the LOW FREQ sector adjust dial to 0.0 and the HIGH FREQ sector adjust dial to 10.0.

3.9.1 EMC-25R ALIGNMENT (Reference Figure 3.3).

a) Select any one frequency band.

b) Depress SINGLE SCAN and STOP. RESET must be off.

c) Using a VTVM, check the voltages at J1-3 and J2-11. Adjust variable resistor R2 (reference Figure 3.4) to equalize these voltages.

d) Depress MANUAL pushbutton. RESET must be off.

e) Using a VTVM, check the voltages at J1-3 and at J2-11. Adjust variable resistor R72 (reference Figure 3.4) to equalize these voltages.

f) Depress SINGLE SCAN and STOP. RESET must be off.

NOTE

The cursor on the band dial must go only to the end of the base line at each extreme. Be sure that the cursor does not fall into the end-play area at the end of the baseline.

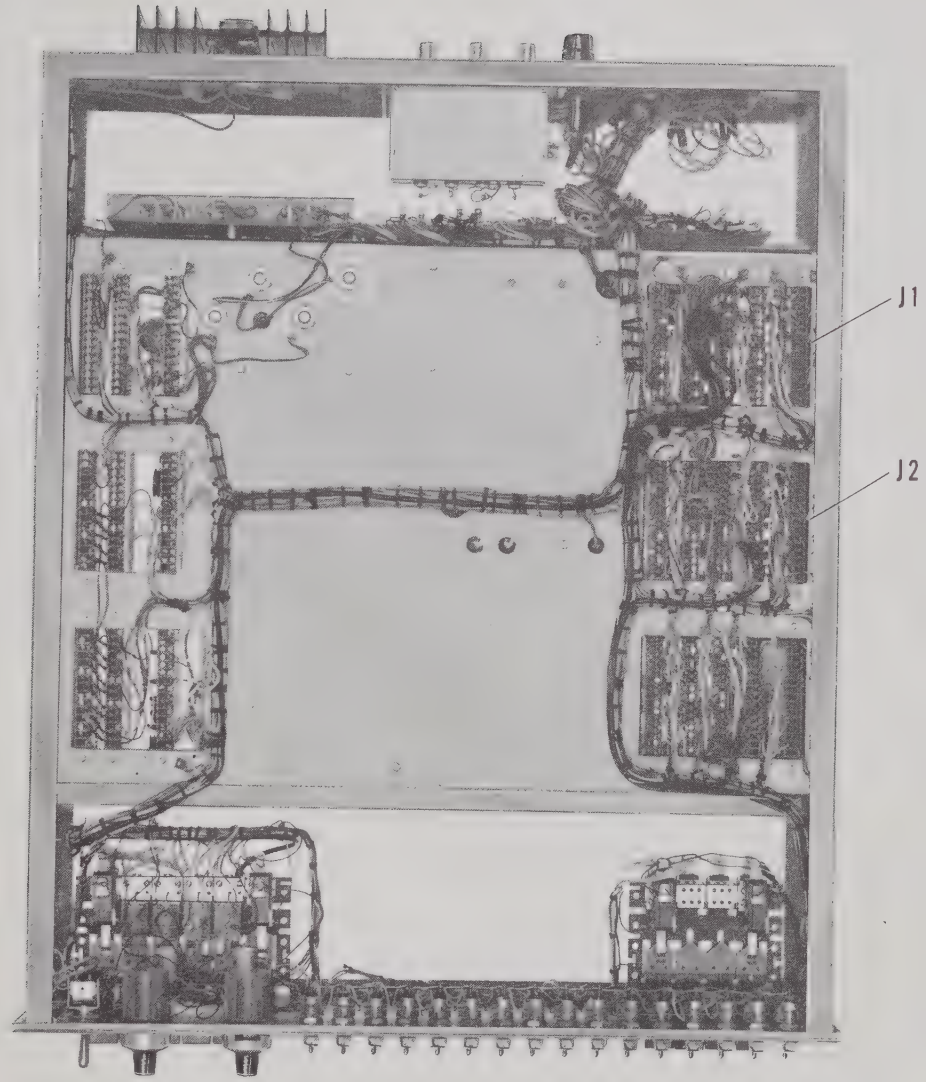
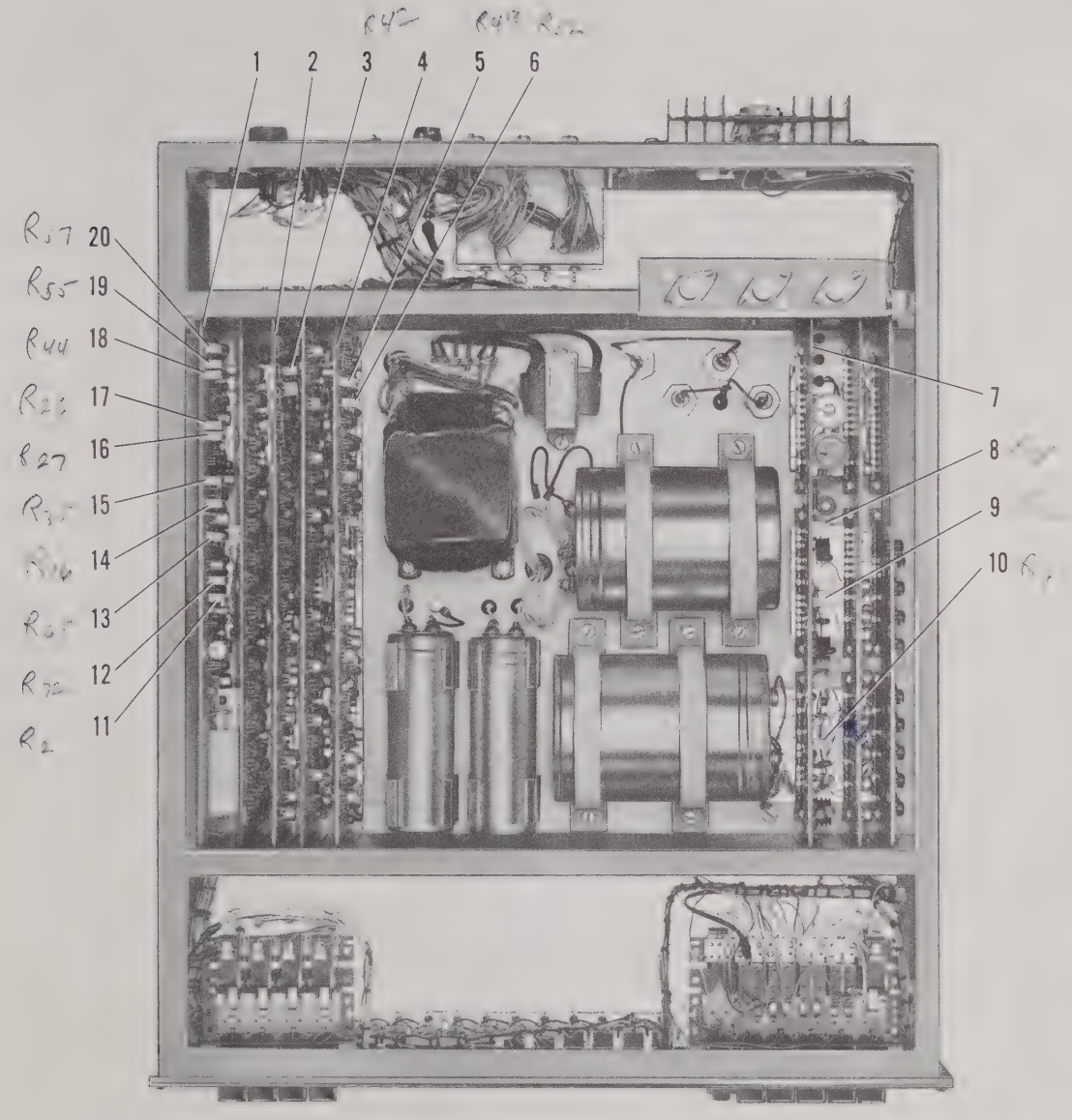


Figure 3.3 Sweep Board Connector Location

g) Adjust the tuning control to bring the cursor to the high end of the dial baseline.
h) Using a VTVM, measure the voltage at J2-11. Record this reading.
j) Adjust the SWEEP RATE pot on the front panel to slow the sweep rate. This allows step l below to be performed more easily.
k) Attach the VTVM to J1-3, and depress the START button.
l) Adjust R16 (reference Figure 3.4) so that, at triggering, the voltage measured at J1-3 is 10 mv above that measured at J2-11 in step h above.
m) Repeat steps c through l above, until R2, R72 and R16 need no further adjustment.
n) Select two or more frequency bands.
p) Attach the VTVM to J1-3, and depress the START button.
r) Adjust R44 (reference Figure 3.4) so that, at triggering, the voltage measured at J1-3 is 10 mv above that measured at J2-11 in step h, above.
s) Press MANUAL button. Adjust tuning control to bring cursor to high end of the dial baseline.
t) Adjust R57 (reference Figure 3.4) such that the pen of the X-Y plotter is at the right edge of the band chart on the paper.
u) Apply a signal of between 14 Hz and 25 MHz at an amplitude of 1 mv to the analyzer.
v) Set ATTENUATOR knob on the analyzer to 40 DB, read on the black scale.
w) Peak the signal and adjust the CAL control on the analyzer for full scale reading.
x) Set ATTENUATOR knob to 20 DB on black scale.
y) Adjust R49 of the bias board (reference Figure 3.4) such that the pen of the X-Y plotter is just below the top edge of the band chart on the paper.
z) Select only one band. Change the paper in the X-Y plotter to single band paper.



1. Sweep Circuit Board
2. State Board
3. Resistor R42
4. Bias Board
5. Resistor R49
6. Resistor R52
7. Regulator Board
8. Resistor R8
9. Resistor R12
10. Resistor R4
11. Resistor R2
12. Resistor R72
13. Resistor R65
14. Resistor R16
15. Resistor R35
16. Resistor R27
17. Resistor R26
18. Resistor R44
19. Resistor R55
20. Resistor R57

Figure 3.4 Alignment Potentiometer Locations

aa) Adjust R52 of the bias board (reference Figure 3.4) such that the pen of the X-Y plotter is just below the top edge of the space allotted for plotting.

bb) MANUAL mode, adjust tuning control to bring cursor to high end of the dial baseline.

cc) Adjust R55 of the sweep board (reference Figure 3.4) such that the pen of the X-Y plotter is at the right edge of the space allotted for plotting.

3.9.2 EMC-10 ALIGNMENT (Reference Figure 3.3). Calibrate EMC-10 frequency according

to EMC-10 Instruction Manual.

a) Select band 0 only.
b) Adjust the tuning control on the analyzer to bring the digital frequency indicator to 00000.
c) Depress the MANUAL button.
d) Using a VTVM, check the voltages at J2-14 and at J1-1. Adjust R65 (reference Figure 3.4) to equalize these voltages.
e) Depress SINGLE SCAN and STOP pushbuttons.
f) Adjust the tuning control on the analyzer to bring the digital frequency indicator to 16 KHz.
g) Using a VTVM, measure the voltage at J2-14. Record this voltage.
h) Depress the START pushbutton.
j) Adjust R35 (reference Figure 3.4) such that, at triggering, the voltage measured at J1-1 is 10 mv above that measured at J2-14 in step g, above.

3.10 PRE-OPERATIONAL CALIBRATION

It is necessary to perform the pre-operational calibration of the system each time the EMC-10 or the EMC-25R is calibrated to the programmer, as described in paragraph 3.9.

3.10.1 CHART PAPER CALIBRATION. Multiband chart paper used with the system must be calibrated in amplitude (Y) for all bands; and in frequency (X) for bands 11 through 15. After calibrating one master chart copies may be made since the frequency and amplitude parameters will be constant. (See paragraph 3.11.)

3.10.1.1 FREQUENCY CALIBRATION. The procedure for calibrating the blank charts into frequency sectors is as follows:

a) Place the DETECTOR FUNCTION switch on the front panel of the EMC-25R to the SLIDEBACK position.
b) Normalize the X-Y plotter by aligning the pen with the chart paper calibration marks as described in paragraph 3.8.
c) Depress the MANUAL pushbutton and the STOP pushbutton on the programmer.
d) Select the frequency band of 25-50 MHz and all higher bands.
e) Set fine tuning control of EMC-25R to mid-range.
f) Adjust the tuning control on the EMC-25R to the first calibration point desired in the chart.
g) Depress the START pushbutton. The pen will now drop on the chart to make a dot at the selected point on the chart.
h) Vary the THRESHOLD control on the EMC-25R from full CCW to full CW. A vertical line will now be drawn by the pen on the chart, to indicate the frequency sector. This eliminates all parallax errors.
j) Depress the STOP pushbutton on the programmer to raise the pen.
k) Repeat steps c through h above, for each frequency calibration point desired within the band.
l) Tune to the next frequency band and repeat steps c through j, above.

3.10.1.2 AMPLITUDE CALIBRATION. The procedure for calibrating the amplitude on the chart for the EMC-10 is as follows:

a) Perform general calibration procedures as described in paragraphs 3.12, 3.12.1, 3.12.2, and 3.12.3 of EMC-10 Instruction Manual.
b) Depress the MANUAL and STOP pushbuttons on the programmer.
c) Select the EMC-10 band (0 - 16 KHz), and at least one other frequency band at the programmer.
d) Tune the EMC-10 analyzer frequency to 00000.
e) Adjust the zero control as described in paragraph 3.12.3 of EMC-10 Instruction Manual.
f) Select the 50 Hz or 250 Hz bandwidth at the EMC-10.

NOTE

The 5 Hz bandwidth can only be used with a sweep time of 15 minutes or more.

g) Set up the analyzer for Manual X-Y Plotting as described in paragraph 3.14.8 of the EMC-10 Instruction Manual and amplitude calibration as in paragraph 3.12.5.
h) Depress the START pushbutton on the programmer. The pen of the X-Y plotter will drop to the paper.
j) Tune the EMC-10 analyzer for a dial reading of 16 KHz. The pen will now draw the 0 DB line across the top of the band chart.
k) Depress the STOP pushbutton at the programmer.
l) Set the AUDIO/SLIDEBACK control on the EMC-10 to the SLIDEBACK position.
m) Set the EMC-10 ATTENUATOR controls to the 10 volts full scale position.
n) Adjust the SLIDEBACK control for a meter reading of -10.

p) Repeat steps h and j above.
r) Depress the STOP pushbutton.
s) Repeat steps n through r above, for dial readings of -20, -30, and -40.

3.10.1.2.1 PLOTTING EMC-10 NOISE LEVEL

a) Ascertain the amplitude level for normal operation of the EMC-10 analyzer in your use. (This will vary according to individual usage.)
b) Set the ATTENUATOR (wide band and narrow band) to this normal position.
c) Remove all signal inputs from the EMC-10.
d) Depress the START pushbutton at the programmer, to allow the EMC-10 to sweep across the band. The pen of the X-Y plotter will draw a "noise level" curve, to plot the noise inherent in the analyzer.

3.10.1.2.2 AMPLITUDE CALIBRATION FOR EMC-25R

a) Ascertain the normal operating amplitude level.
b) Using instructions supplied with the Fairchild Electro-Metrics CLC-25 (Calibrator Level Control), or an external impulse generator, apply an IG input to the EMC-25R analyzer.
c) The ATTENUATOR must now be set as required for either maximum sensitivity (low DB values) or maximum dynamic range (high DB values) as indicated by operator experience.
d) Select frequency bands 1 through 7 (14 KHz to 2.4 MHz) at the programmer.
e) Remove all inputs to the EMC-25R, and cap the input connector.
f) Depress the SINGLE-SCAN and START pushbuttons at the programmer. The pen of the X-Y plotter will plot the noise level of the system on band charts 1 through 7.
g) Set up the Fairchild Electro-Metrics CLC-25 or an external impulse generator to produce an input to the EMC-25R analyzer which is at least 10 DB above the noise level line.
h) Depress the START pushbutton and scan bands 1 through 7. The pen of the X-Y plotter will plot this line for these bands.
j) Set up the Fairchild Electro-Metrics CLC-25 or external impulse generator for successive inputs of 20 DB above noise, 30 DB above noise, 40 DB above noise, etc., until the analyzer becomes saturated. Repeat step f above for each successive signal input.
k) Place switches for bands 1 through 7 in the down position. Select only the frequency bands between 2.3 MHz and 1000 MHz.
l) Repeat the procedures listed in è through j above. The pen of the X-Y plotter will plot the amplitude reference levels for bands 8 through 15.

NOTE

The dynamic range of the EMC-25R analyzer is affected by the setting of the CAL control. Experience with the EMC-25R will allow the operator to determine the optimum setting of this control. Also, it is important that the DUMP control be set correctly. The proper setting for the DUMP control is to keep it set as far clockwise as possible, without incurring loss of the signal amplitude plot.

3.11 CHART PAPER REPRODUCTION

Once the programmer, the EMC-25R, the EMC-10 and the X-Y plotter have been calibrated as a compatible system, the chart paper with the reference calibration marks may be reproduced to be used with the system. It is important that the reproduced copies have exact parallelism between the bottom line of the chart paper and the bottom edge of the paper itself. If this condition is not met, errors will be introduced into the plots because the paper will not align correctly in the X-Y plotter.

SECTION IV
SERVICE AND MAINTENANCE

4.1 GENERAL

This section includes material necessary for the proper calibration, maintenance and repair of the ESC-125A. Failure to follow these procedures could violate the terms of the manufacturer's warranty, in addition to limiting the reliability of the instrument.

4.2 INSTRUMENT ACCESS

To gain access to the interior of the instrument, remove the four screws at the rear of the instrument and the two screws on the bottom of the instrument. Slide the instrument out of its case from the front.

The instrument must be removed from its case in order to replace or test any of the components or subassemblies.

4.3 TROUBLESHOOTING

The procedure for troubleshooting the ESC-125A is the same as for any other electronic device. This consists of pinpointing the source of malfunction by logically eliminating alternate possibilities. Eliminating the greatest number of possibilities with any one check will quickly narrow the remaining choices until the defective component or circuit is isolated.

A malfunction should indicate which functional circuit is defective. For instance, if the sweep voltage is not correct, the problem is most likely located on the sweep board. Reference to the Theory of Operation, Section II, explains the operation of each functional circuit. Figure 4.1 illustrates the physical location of the circuits, and the figure numbers for the applicable schematic diagrams in Section VII, to aid in tracing the circuits.

Figure 4.2 shows component and printed circuit board locations in the chassis. Figure 4.3 shows chassis wire routing.

If a micrologic element is found to be defective, it is recommended that the entire printed circuit board be replaced.

4.4 PRINTED CIRCUIT BOARD MAINTENANCE

Should a printed circuit board become heavily damaged, or the printed circuit marred in any way to affect circuit performance, it is recommended that the entire assembly be reordered from the manufacturer.

CAUTION

Do not remove circuit boards while power is on. Check that power switch is in "down" position.

When removing printed circuit boards, use an extractor tool or smooth-faced, non-serrated pliers in order to avoid damage to the board.

When re-installing printed circuit boards in the ESC-125A, be sure to snap the board firmly into place. In doing so, apply pressure evenly along the top edge of the board. The printed circuit boards of the ESC-125A are keyed such that a board cannot be inserted into the wrong connector or placed in backwards. If difficulty is found in placing a board into a connector do not force the board. Make sure it is the right board for the connector, and check the keying.

When servicing printed circuit boards, it is required to use alignment circuit board extender ECB-125.

NOTE

When handling printed circuit boards, observe the following precautions.

a) Never allow the printed circuit to come into contact with abrasive surfaces or objects. This can cause aberrations in the surface conductivity and create unwanted capacitance.
b) Never touch the printed circuit surface with bare fingers; skin oils can create conductive paths.
c) Avoid excessive heat when repairing a board. This could cause the circuit and board to separate.
d) After repairing a printed circuit, clean the printed surface of all contaminants.

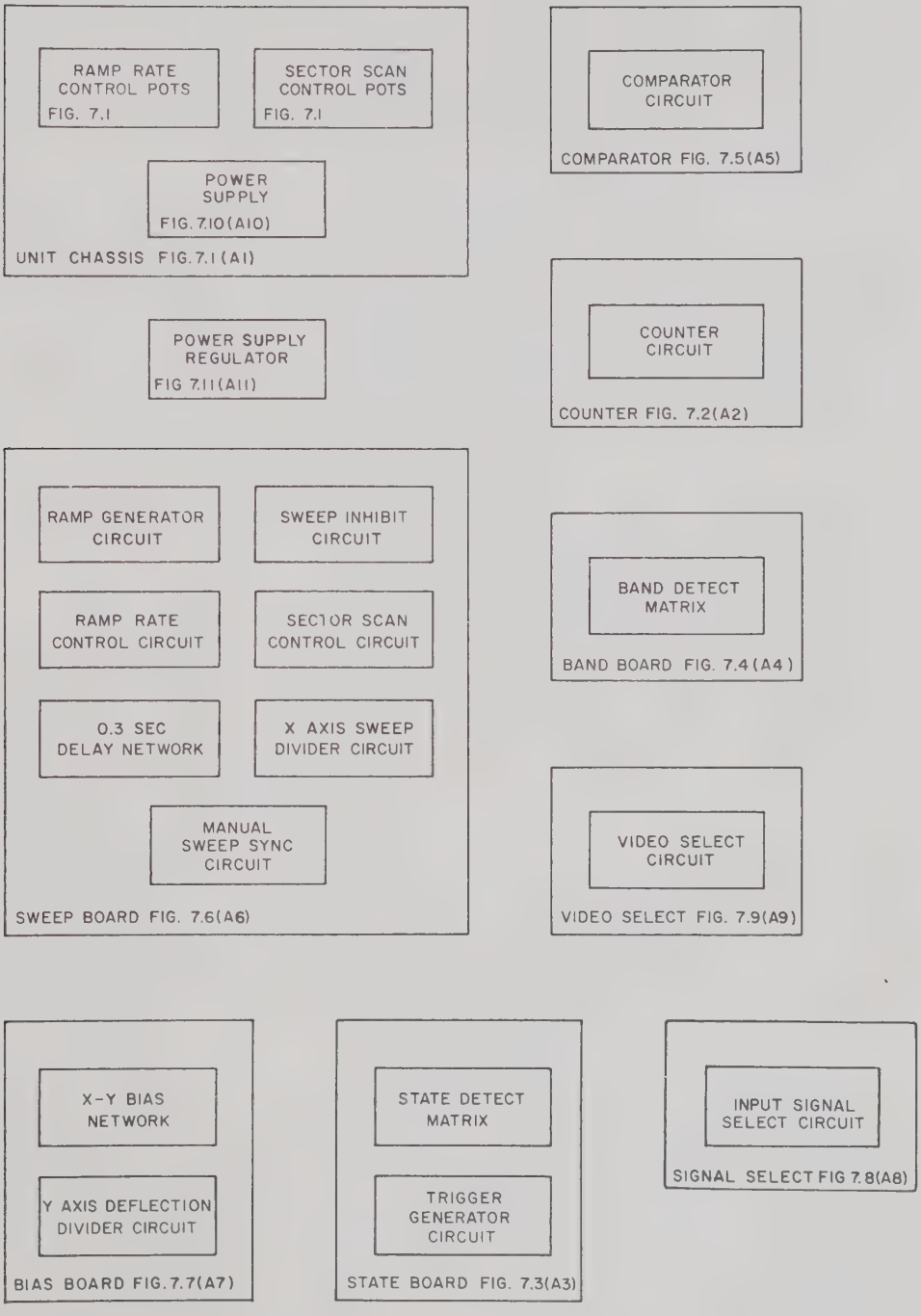
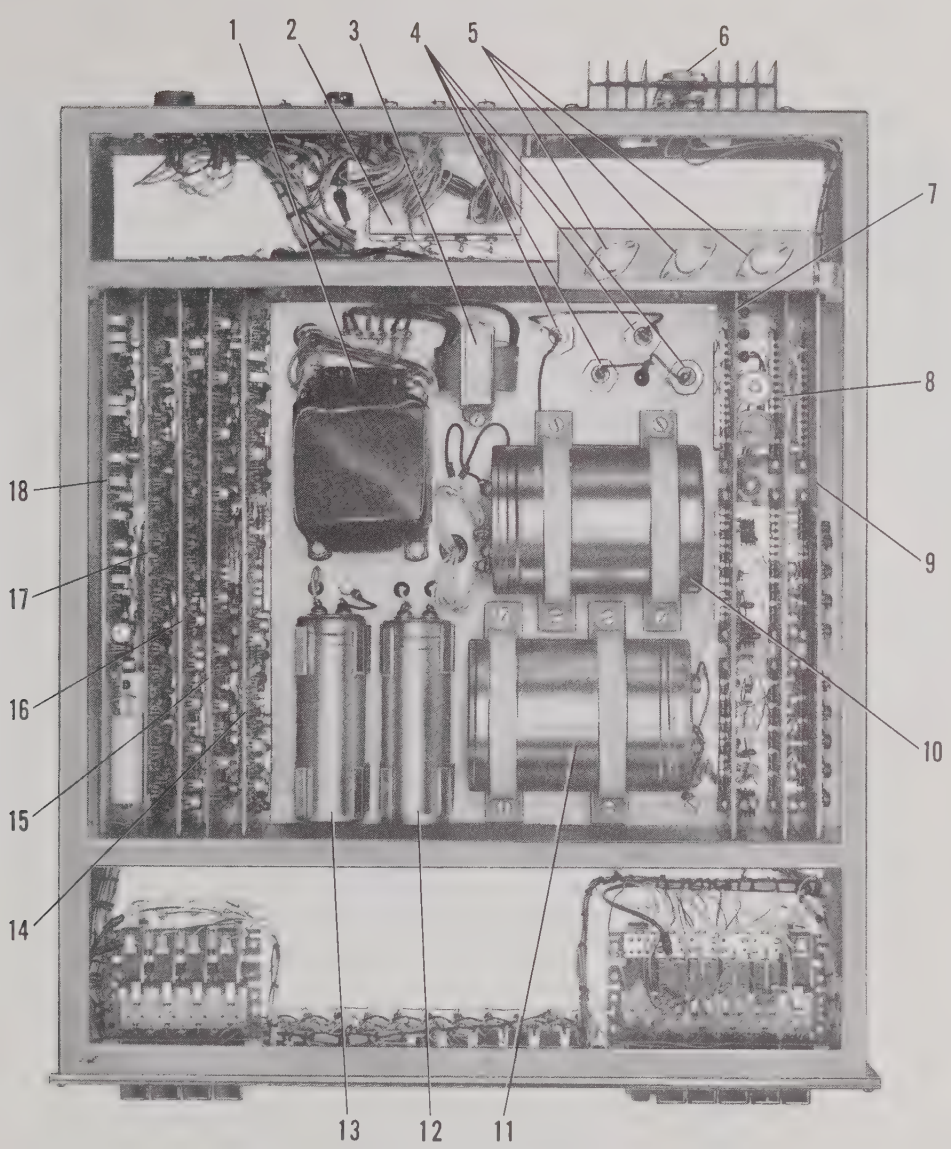
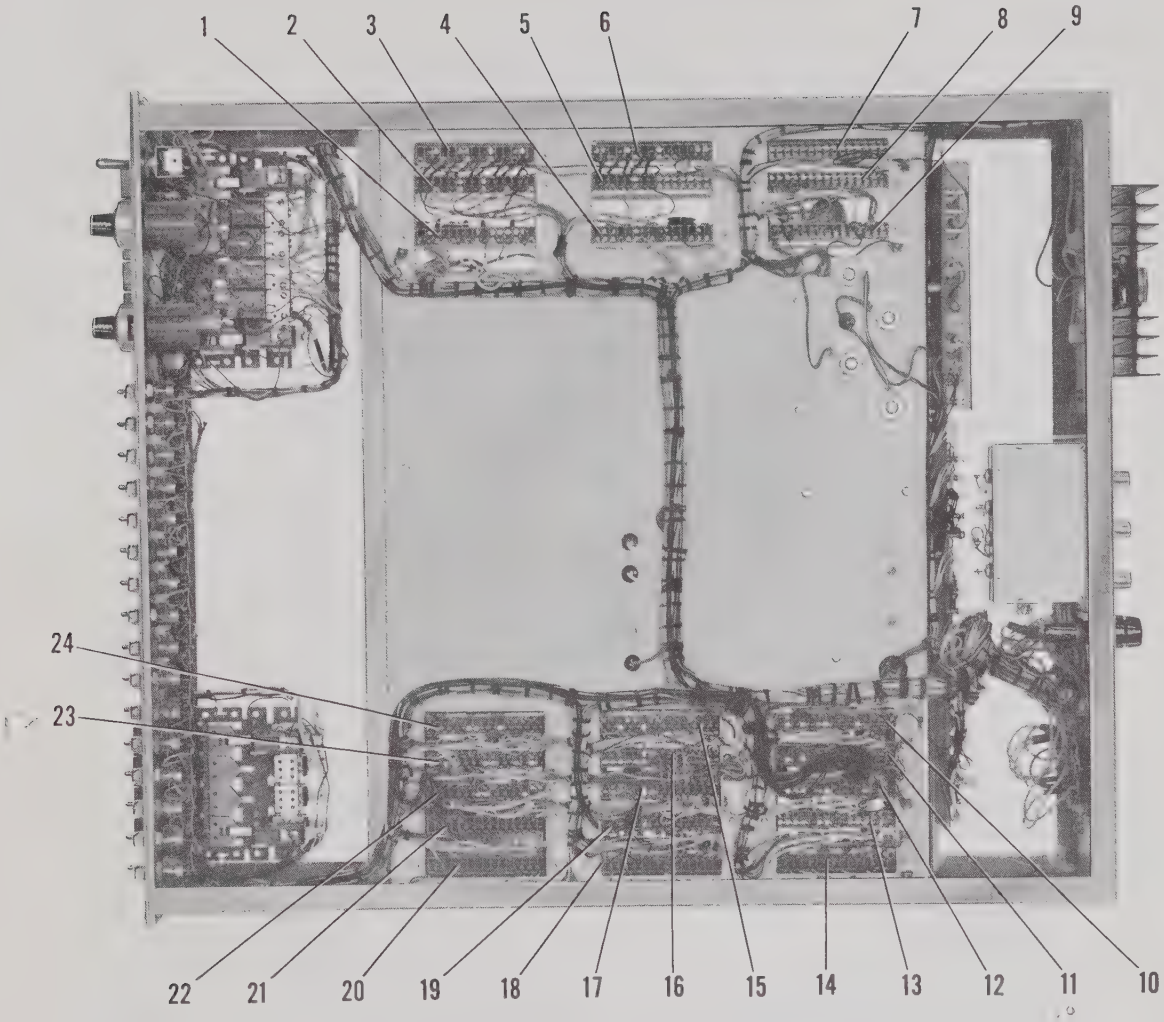


Figure 4.1 Functional Circuit Physical Location



1. Power Supply Transformer T1
2. Video Select Circuit
3. Power Supply Transformer T2
4. Power Supply Diodes CR9 through CR12
5. Power Supply Transistors Q6, Q7, Q10
6. Power Supply Transistors Q8, Q9
7. Power Supply Regulator Board
8. Comparator Board
9. Band Detect Matrix Board
10. Power Supply Capacitor C3
11. Power Supply Capacitor C2
12. Power Supply Capacitor C1
13. Power Supply Capacitor C4
14. Bias Board
15. Signal Select Circuit Board
16. State Detect Matrix Board
17. Counter Board
18. Sweep Circuit Board

Figure 4.2 Component and PC Board Location



1. Jack J18
2. Jack J21
3. Jack J24
4. Jack J17
5. Jack J20
6. Jack J23
7. Jack J22
8. Jack J19
9. Jack J16
10. Jack J13
11. Jack J10
12. Jack J7
13. Jack J4
14. Jack J1
15. Jack J14
16. Jack J11
17. Jack J8
18. Jack J2
19. Jack J5
20. Jack J3
21. Jack J6
22. Jack J9
23. Jack J12
24. Jack J15

Figure 4.3 Connector Location

e) To clean, use a weak solution of warm water and mild detergent.
f) Be sure to clean excess solder and resin from board to insure that excess has not created new circuit paths.

4.5 PACKAGING FOR SHIPMENT

Should it become necessary to return the instrument, a component, or an accessory to the factory for repair or replacement, package in accordance with the following procedure.

a) Repackage in original shipping carton, if available.
b) If original container is not available package in cardboard carton, cushioning all sides with a resilient material. Pack material firmly around the instrument so as to prevent motion.
c) Seal cardboard container with cloth shipping tape.
d) Package sealed cardboard container within a securely fitted wood slat crate.
e) Wire tie crate with approved crating wire and mark "FRAGILE" on all sides.
f) Enclose packing slip for every item shipped.

NOTE

Before packaging instrument, list on your letterhead the serial number of the instrument, the nature of the malfunction and the name of an individual whom the manufacturer can contact for additional information. PLEASE INCLUDE RETURN SHIPPING ADDRESS.

NOTE

In the case of small components or accessories it is not necessary to package in a wood crate.

SECTION V
ACCESSORY DATA

5.1 GENERAL

This section contains a list (Table 5-1) and information about the accessories that are designed for operation with the ESC-125A Programmer.

TABLE 5-1

ACCESSORY LIST

1) Input Signal Switching Unit (SU-125)
2) Cables
   a) EMC-10 (4656-1)
   b) EMC-25R (4657-1)
   c) Input Signal Switching Unit (4660-1)
   d) Power Cord (PCD-25)
   e) Coax Cable (CAC-25) (2)
   f) Coax Cable (CAB-10)
3) Carrying Case
4) Extender Board (EXB-125)
5) Adapter Brackets for 19-inch mounting (ABA-125)
6) Patch Cords (18) (1471-3-03-10)
7) Dummy Plug (4650)

5.2 INPUT SIGNAL SWITCHING UNIT (SU-125)

The input signal switching unit routes the incoming signal to the analyzer selected by the programmer. Various signal connections are accomplished by connecting patch cords between jacks on a patch board in the switching unit. Figure 5.1 shows the signal input-output connectors on the switching unit. Figure 5.2 shows the signal switching relays and the patch board.

Relay K8, K7, K10 or K9 routes the selected signal from J81, J82, J83 or J84 through J85, out to one of the analyzers. Relay K2, K1, K4, K3, K6 or K5 routes the selected signal from J74, J75, J76, J77, J78 or J79 through J80, out to the other analyzer. Switching information and power for remote antennas are delivered through J1 and J2.

Input signal connector selection is controlled by the input signal select circuit in the programmer. This information is fed to the patch board. By means of patching, the operator may select any of the 10 relays to be actuated for any particular state of the programmer, thus selecting the connector required. Figure 5.3 shows the location of each connector on the patch board. Connector J3 will be active when the programmer has selected the frequency band assigned to the EMC-10 analyzer (band 0). Connectors J4 through J18 are associated with the EMC-25R analyzer. Table 5-2 lists the frequency bands associated with the patch board connectors.

TABLE 5-2

INPUT SIGNAL SELECTION

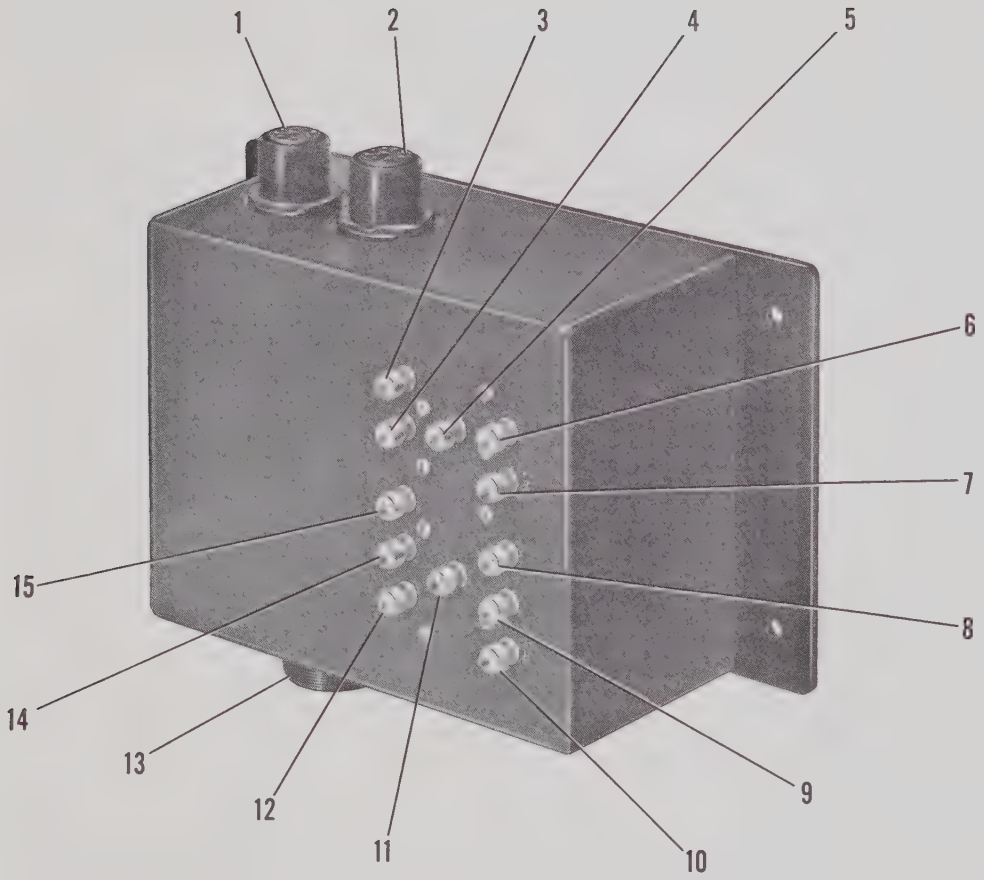
Frequency Band		Patch Board Connector
EMC-10 Band		J3
EMC-25	Band 1	J4
	Band 2	J5
	Band 3	J6
	Band 4	J7
	Band 5	J8
	Band 6	J9
	Band 7	J10
	Band 8	J11
	Band 9	J12
	Band 10	J13
	Band 11	J14
	Band 12	J15
	Band 13	J16
	Band 14	J17
	Band 15	J18

Connector J86 or J87 is used to loop the impulse generator signal from the analyzer and back. These connectors are active when the CAL switch is depressed at the programmer.

Relay power and connector selection information are delivered to the switching unit from the programmer through connector P1.

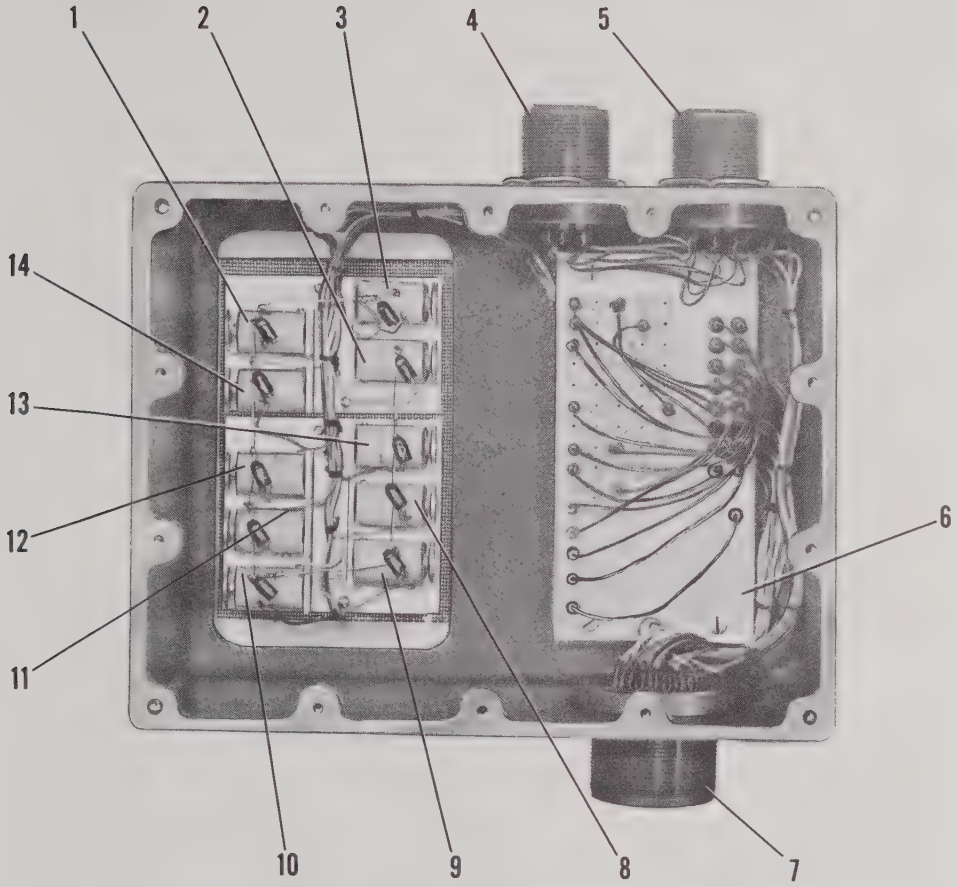
Table 5-3 shows the relationship between the components shown in Figures 5.1, 5.2 and 5.3. By means of patching between the patch board connectors listed in Table 5-2 and the patch board connectors listed in Table 5-3, various signal input connectors may be selected for each output connector. For example, by patching J9 to J24, and J10 to J25, signal input connector J76 will be selected when bands 6 or 7 are being scanned.

The switching unit will be programmed by the operator with the patch cords, in order to obtain the desired input/output combinations. In normal use, this arrangement will be unchanged, once it has been selected.



1. Remote Antenna Control Connector, J1
2. Remote Antenna Control Connector, J2
3. Signal Input Connector, J84
4. Signal Input Connector, J82
5. Signal Output Connector, J85
6. Signal Input Connector, J83
7. Signal Input Connector, J81
8. Signal Input Connector, J78
9. Signal Input Connector, J76
10. Signal Input Connector, J74
11. Signal Output Connector, J80
12. Signal Input Connector, J75
13. Switching and Power Connector, P1
14. Signal Input Connector, J77
15. Signal Input Connector, J79

Figure 5.1 Signal Input-Output Connectors



1. Coaxial Relay, K10
2. Coaxial Relay, K7
3. Coaxial Relay, K9
4. Remote Antenna Control Connector, J2
5. Remote Antenna Control Connector, J1
6. Patch Board
7. Switch and Power Connector, P1
8. Coaxial Relay, K3
9. Coaxial Relay, K1
10. Coaxial Relay, K2
11. Coaxial Relay, K4
12. Coaxial Relay, K6
13. Coaxial Relay, K5
14. Coaxial Relay, K8

Figure 5.2 Signal Switching Unit - Component Location

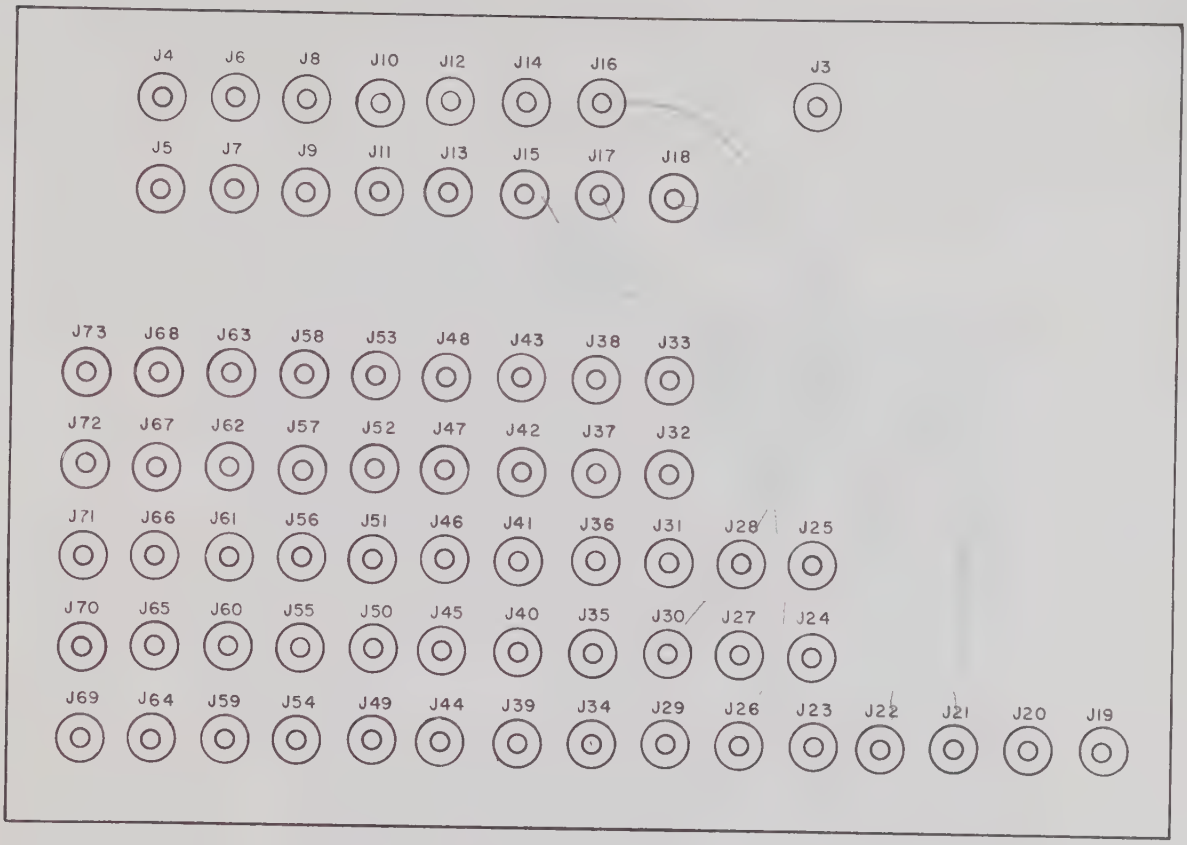


Figure 5.3 Patch Board Connections

TABLE 5-3

INPUT/OUTPUT CONNECTOR SELECTION

	Signal Input Connector	Signal Output Connector	Associated Coaxial Relay	Patch Board Connector
Group 1	J74	J80	K2	CAL Command
	J75	J80	K1	J19-J22
	J76	J80	K4	J23-J28
	J77	J80	K3	J29-J33
	J78	J80	K6	J34-J43
	J79	J80	K5	J44-J58
Group 2	J81	J85	K8	CAL Command
	J82	J85	K7	J59-J63
	J83	J85	K10	J64-J68
	J84	J85	K9	J69-J73

Input signal connectors J74 and J81 are used only for calibrating the interference analyzers. Relays K2 and K8 are actuated when the CAL button of the ESC-125A is depressed.

Input signal devices are connected to connectors J75-J79, in any number and combination. The programming (or pathing) of these is as described above. The IG output of the EMC-25R is connected to J74, and J80 is connected to the RF input connector of the EMC-25R. Thus, when the CAL button of the ESC-125A is depressed, the IG signal from the EMC-25R will

be routed to its input connector, and the EMC-25R can be calibrated. When scanning, the signal from the appropriate input signal device will be routed to the RF input of the EMC-25R.

The EMC-10 can be calibrated in a similar manner using connectors J81-J85.

5.3 X-Y PLOTTER

Any X-Y plotter which is to be controlled by the ESC-125A Programmer must meet the following specifications.

X-Axis Scale Factor:	Nominal 1 mv/in, adjustable to 150 mv/in.
Y-Axis Scale Factor:	Nominal 40 mv/in, adjustable to 400 mv/in.
Input Impedance:	Y = 100K ohms (min) X = 100K ohms (min)
Accuracy (both axes):	± 0.2% of full scale
Repeatability:	± 0.05% of full scale
Slewing Speed (both axes):	20 in/sec (min)
Controls:	X axis ZERO Y axis ZERO
Pen Lift:	Pen lowers when external contacts close.

5.4 ACCESSORY INTERCONNECTION

Figure 5.4 shows typical interconnections for the various units. The transducers or antennas are connected to the appropriate jacks on the switching unit.

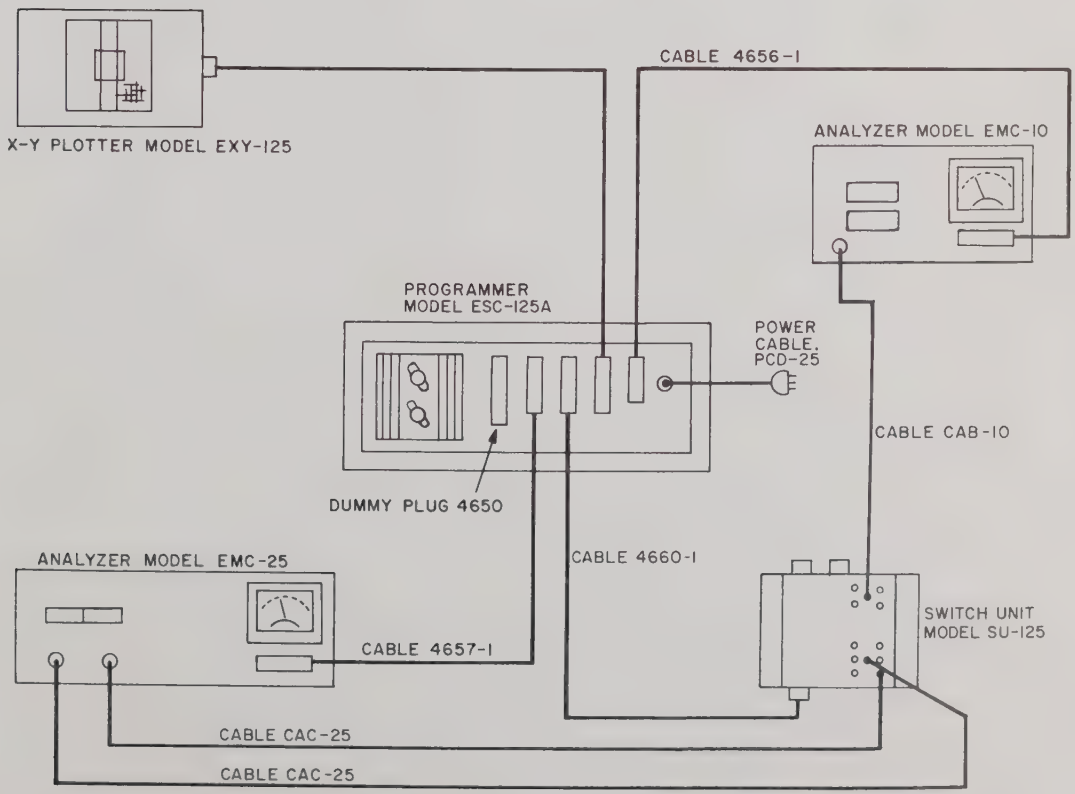


Figure 5.4 Typical ESC-125A Interconnection Diagram

SECTION VI
REPLACEMENT PARTS

6.1 GENERAL

This section includes information which will be of assistance in the location and reordering of components.

6.2 ELECTRONIC COMPONENTS

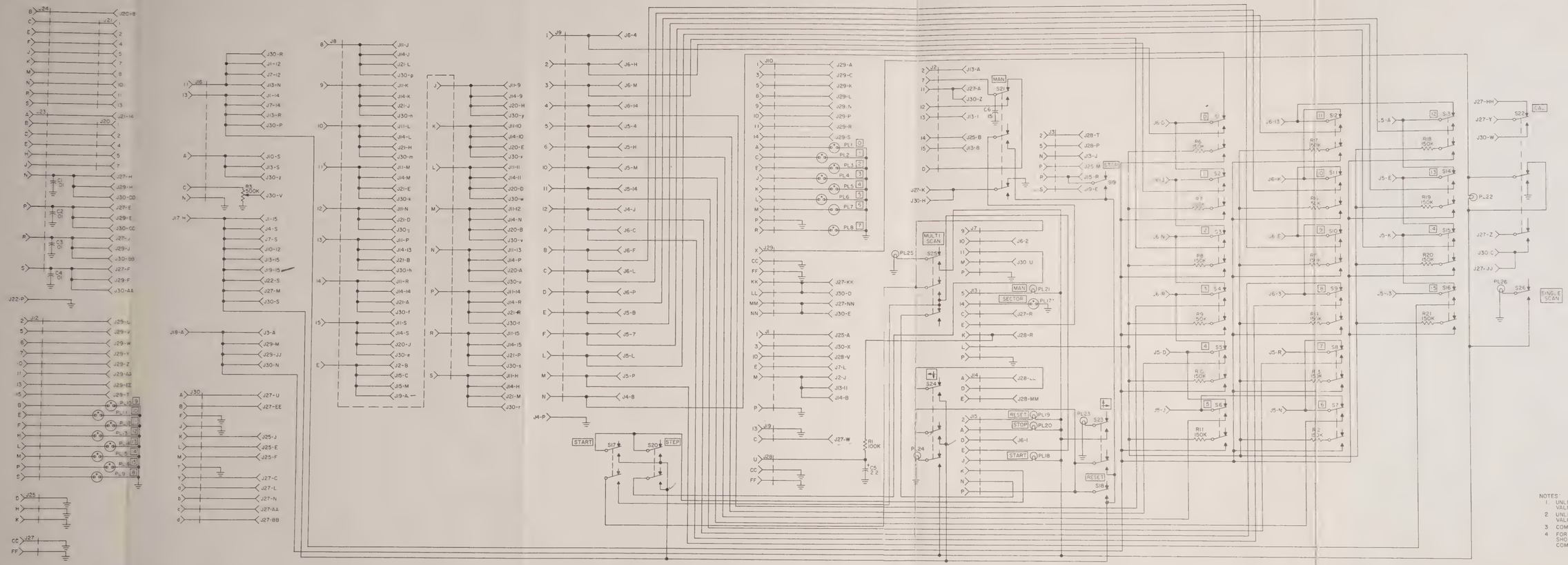
The ordering part numbers of electronic components, indicated on the schematic diagrams, are formed by adding the component designation to the assembly number. The part numbers of non-assembly components are listed in full on the schematic diagram in Section VII.

Replaceable electronic components are those which form part of an accessible circuit.

SECTION VII
REFERENCE DATA

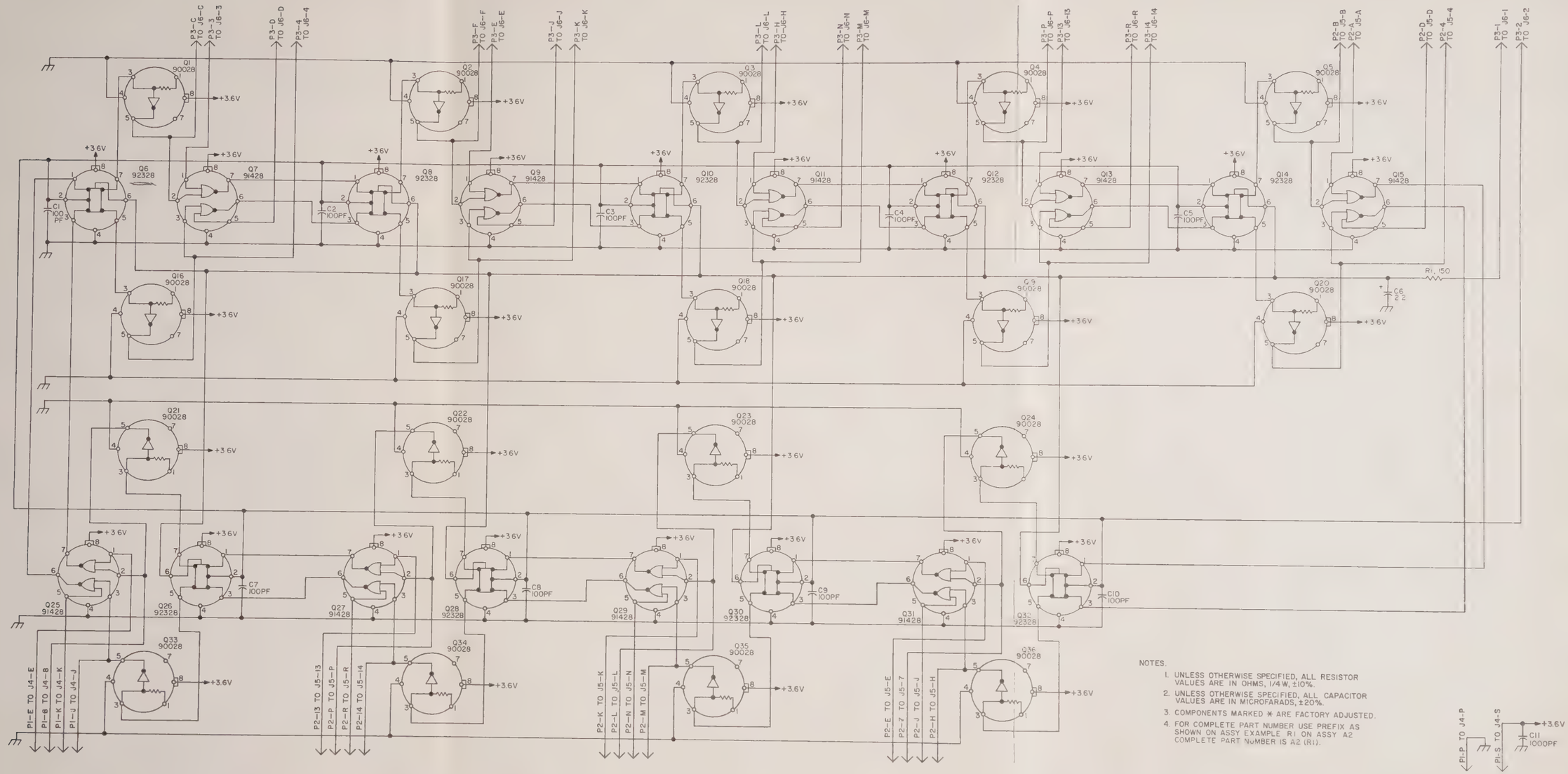
7.1 GENERAL

This section contains schematic diagrams for the ESC-125A Programmer and the Antenna Switching Unit. Schematic drawings are presented, as near as possible, in the order in which the circuits were discussed under Section II. Figure 4.1, Section IV, illustrates the functional circuits contained in the schematic drawings, to aid in circuit location during troubleshooting.



NOTES:
1. UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS, 1/4W, ± 10%
2. UNLESS OTHERWISE SPECIFIED, ALL CAPACITOR VALUES ARE IN MICROFARADS, ± 10%
3. COMPONENTS MARKED ✱ ARE FACTORY ADJUSTED
4. FOR COMPLETE PART NUMBER USE PREFIX AS SHOWN ON ASSY. EXAMPLE R6 ON ASSY A1 COMPLETE PART NUMBER IS A1 (R6)

Figure 7.1 Programmer Main Chassis (A1)



NOTES.

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS, 1/4W, ±10%.
2. UNLESS OTHERWISE SPECIFIED, ALL CAPACITOR VALUES ARE IN MICROFARADS, ±20%.
3. COMPONENTS MARKED * ARE FACTORY ADJUSTED.
4. FOR COMPLETE PART NUMBER USE PREFIX AS SHOWN ON ASSY EXAMPLE R1 ON ASSY A2 COMPLETE PART NUMBER IS A2 (R1).

Figure 7.2 Counter Board (A2)

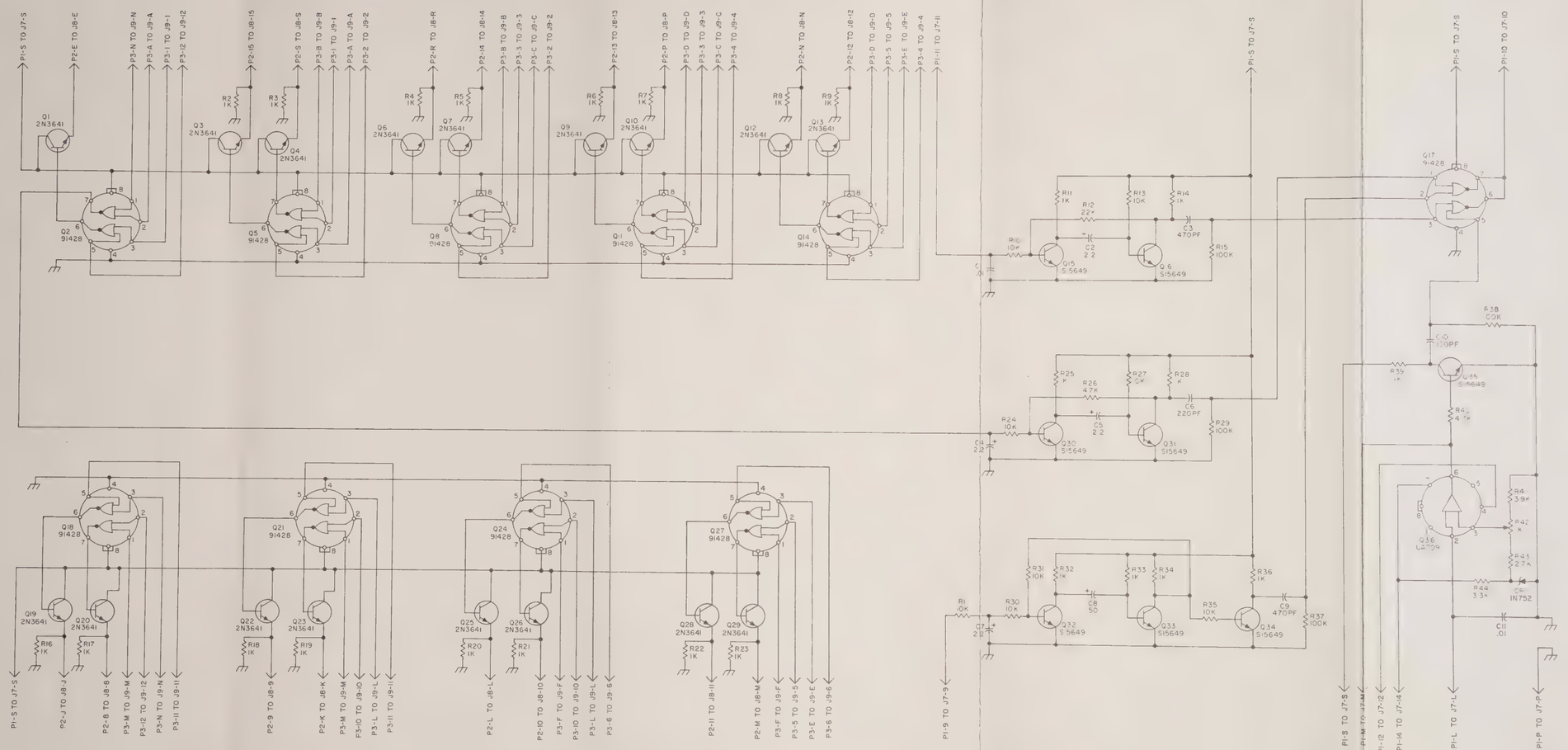

NOTES
1 UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS, 1/4W, ±10%.
2 UNLESS OTHERWISE SPECIFIED, ALL CAPACITOR VALUES ARE IN MICROFARADS, ±20%.
3 COMPONENTS MARKED * ARE FACTORY ADJUSTED
4 FOR COMPLETE PART NUMBER USE PREFIX AS SHOWN ON ASSY EXAMPLE R12 ON ASSY A3 COMPLETE PART NUMBER IS A3 (R12)

Figure 7.3 State Detect Board (A3)

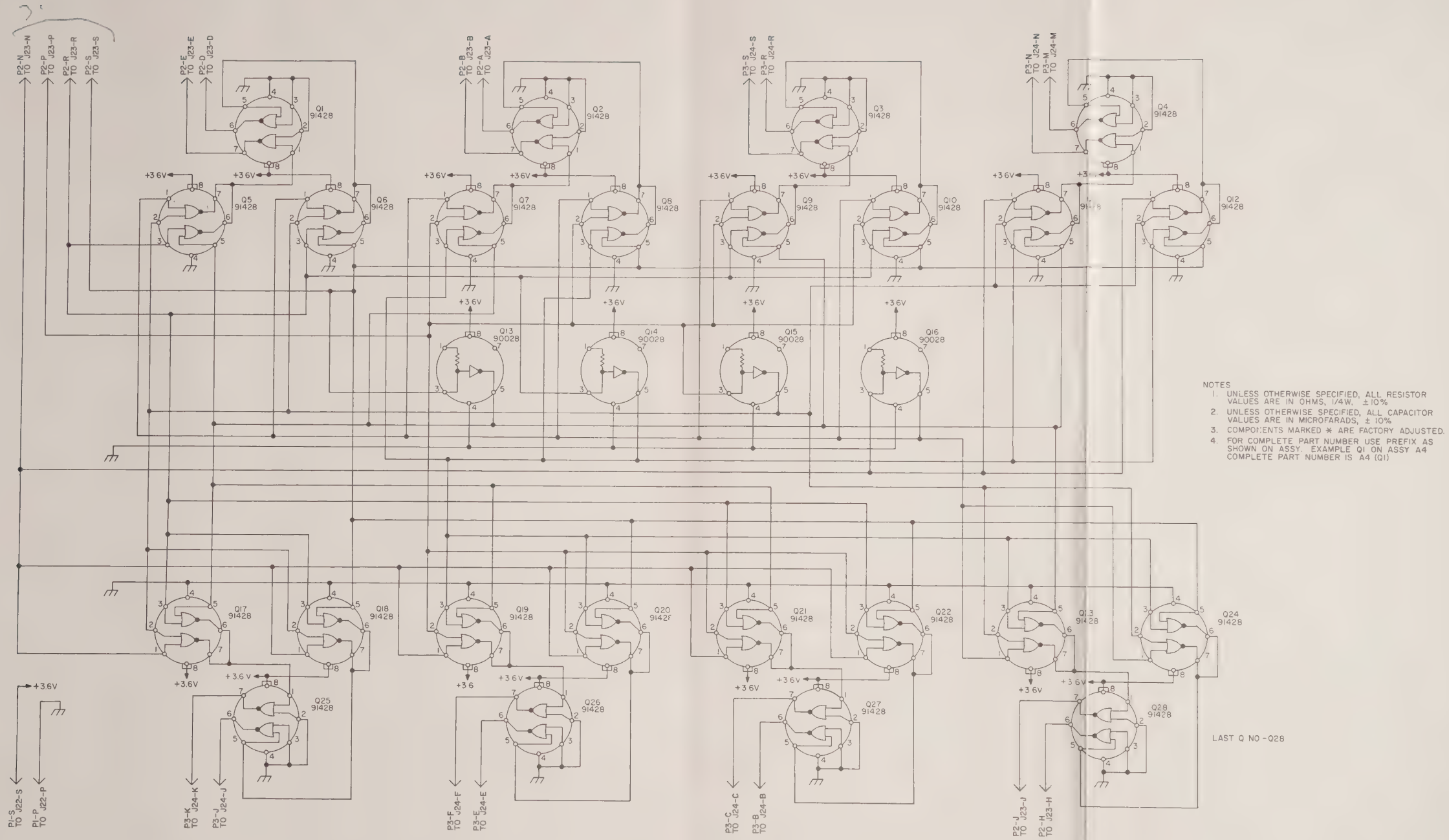
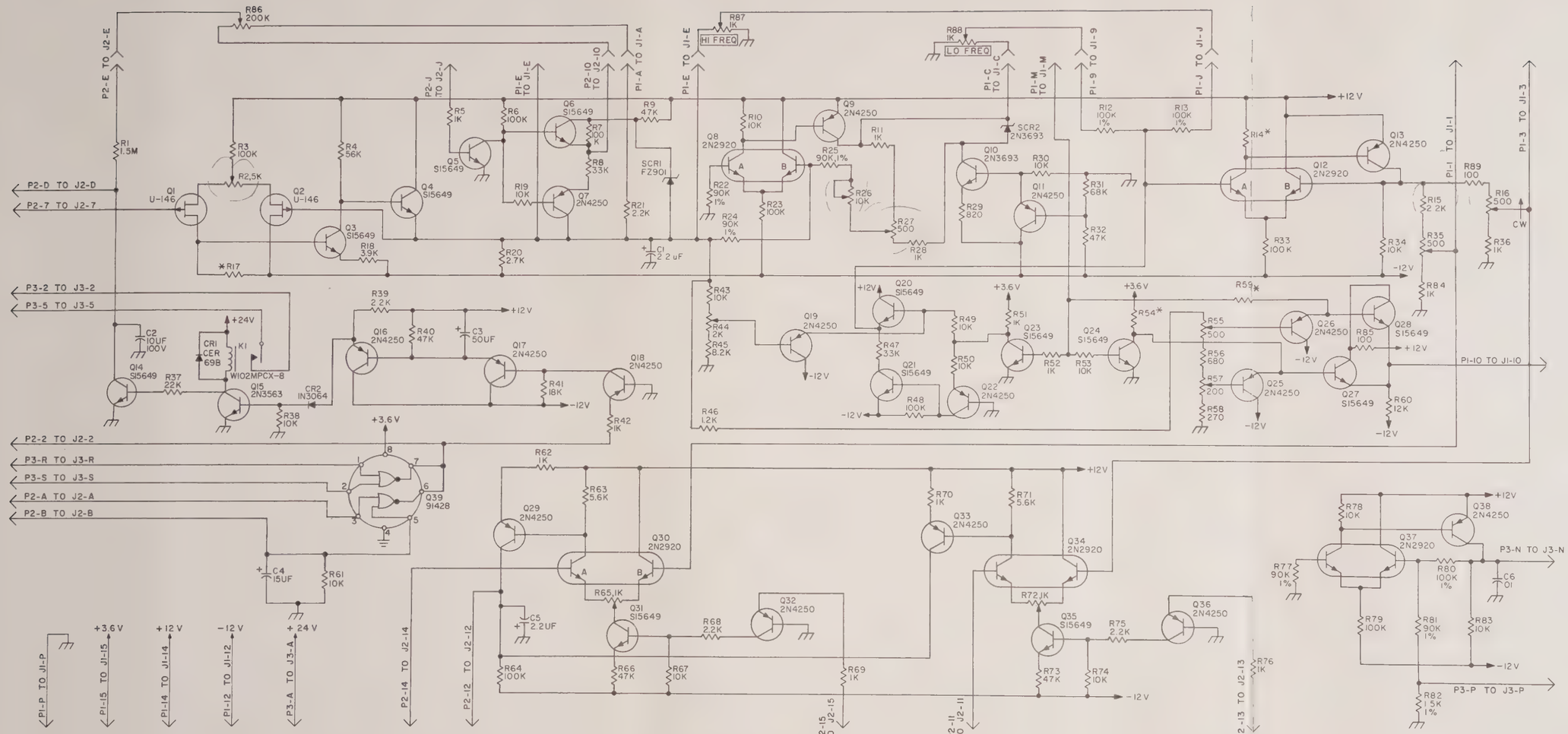
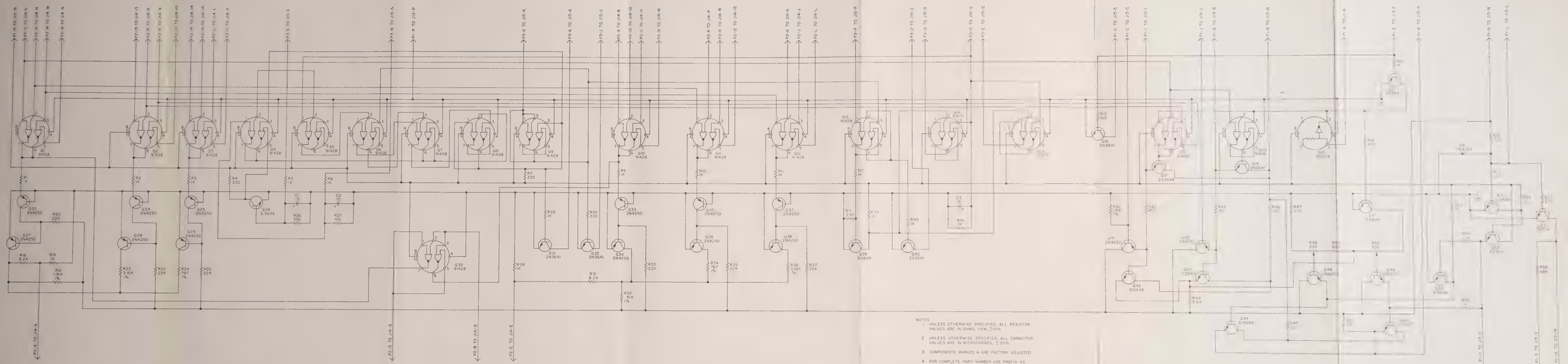


Figure 7.4 Band Detect Board (A4)



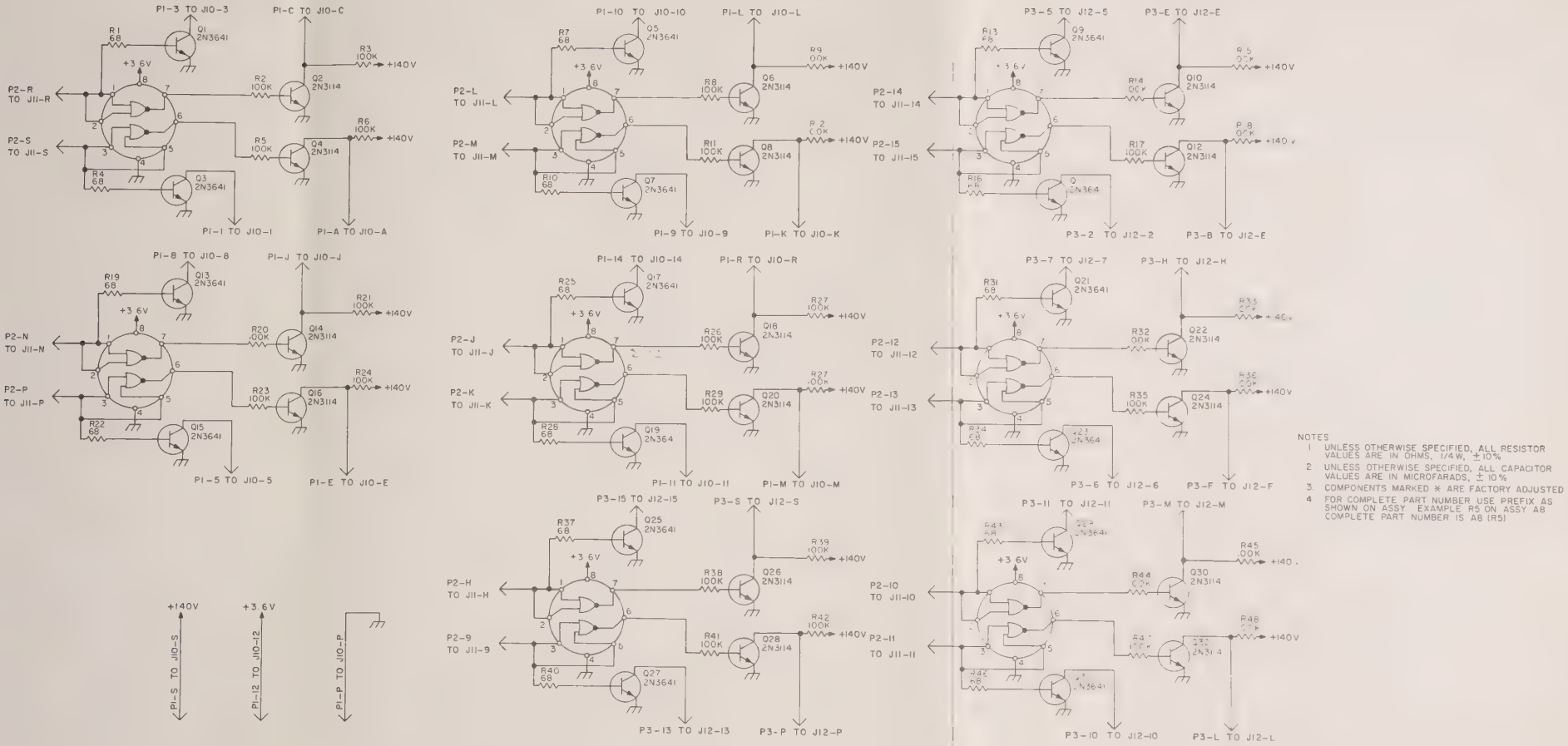
NOTES:
1. UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS, 1/4W, ±10%.
2. UNLESS OTHERWISE SPECIFIED, ALL CAPACITOR VALUES ARE IN MICROFARADS, ± 10%.
3. COMPONENTS MARKED * ARE FACTORY ADJUSTED.
4. FOR COMPLETE PART NUMBER USE PREFIX AS SHOWN ON ASSY. EXAMPLE R5 ON ASSY A6 COMPLETE PART NUMBER IS A6 (R5).

Figure 7.6 Sweep Board (A6)



NOTES:
1. UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS, 1/4W, ±10%
2. UNLESS OTHERWISE SPECIFIED, ALL CAPACITOR VALUES ARE IN MICROFARADS, ±20%
3. COMPONENTS MARKED # ARE FACTORY ADJUSTED
4. FOR COMPLETE PART NUMBER USE PREFIX AS SHOWN ON ASSY. EXAMPLE R3 ON ASSY. A7 COMPLETE PART NUMBER IS A7 R3)

Figure 7.7 Bias Board (A7)



NOTES
1. UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS, 1/4W, ±10%
2. UNLESS OTHERWISE SPECIFIED, ALL CAPACITOR VALUES ARE IN MICROFARADS, ± 10%
3. COMPONENTS MARKED * ARE FACTORY ADJUSTED
4. FOR COMPLETE PART NUMBER USE PREFIX AS SHOWN ON ASSY EXAMPLE R5 ON ASSY A8 COMPLETE PART NUMBER IS A8 (R5)

Figure 7.8 Signal Select Board (A8)

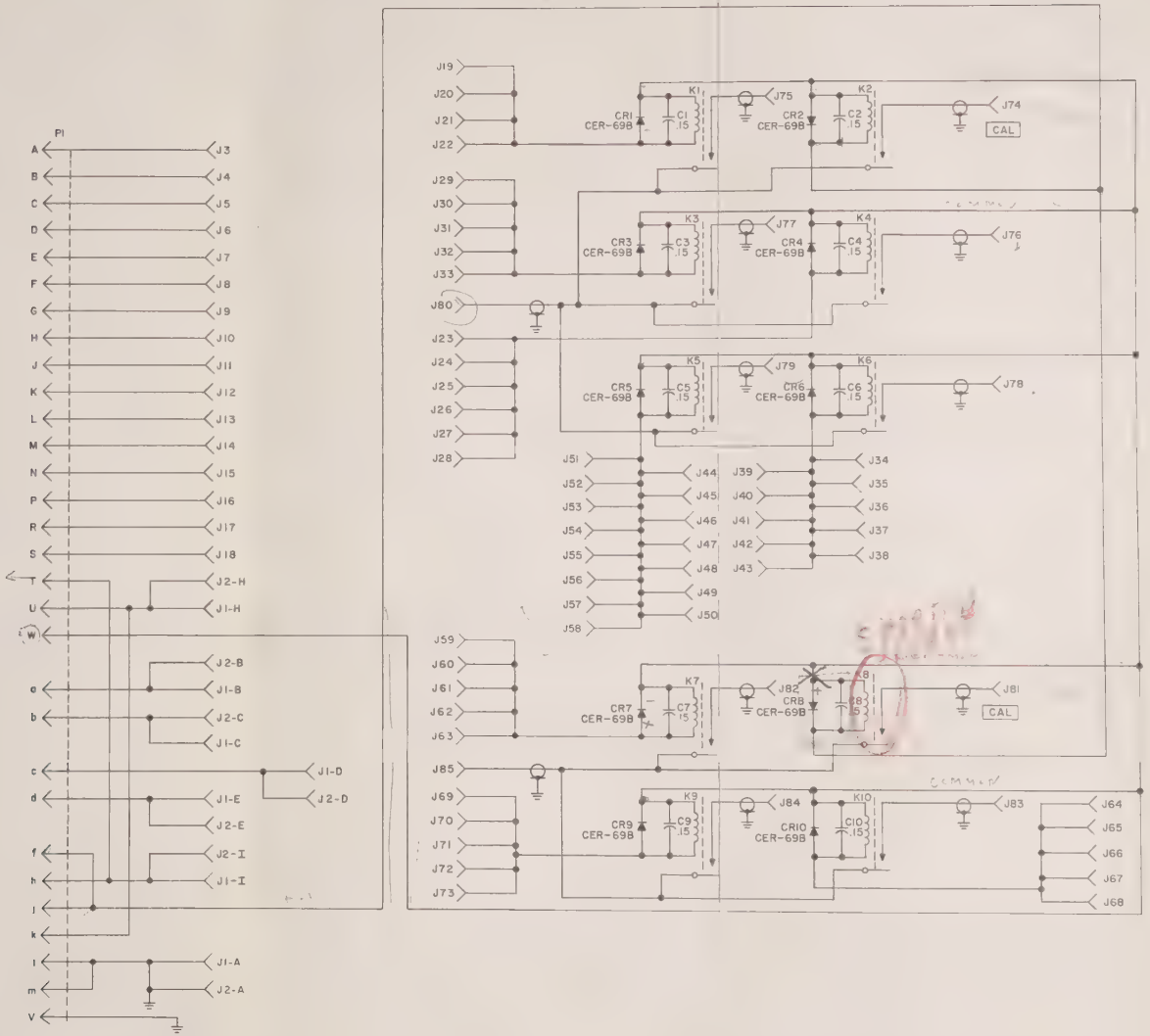
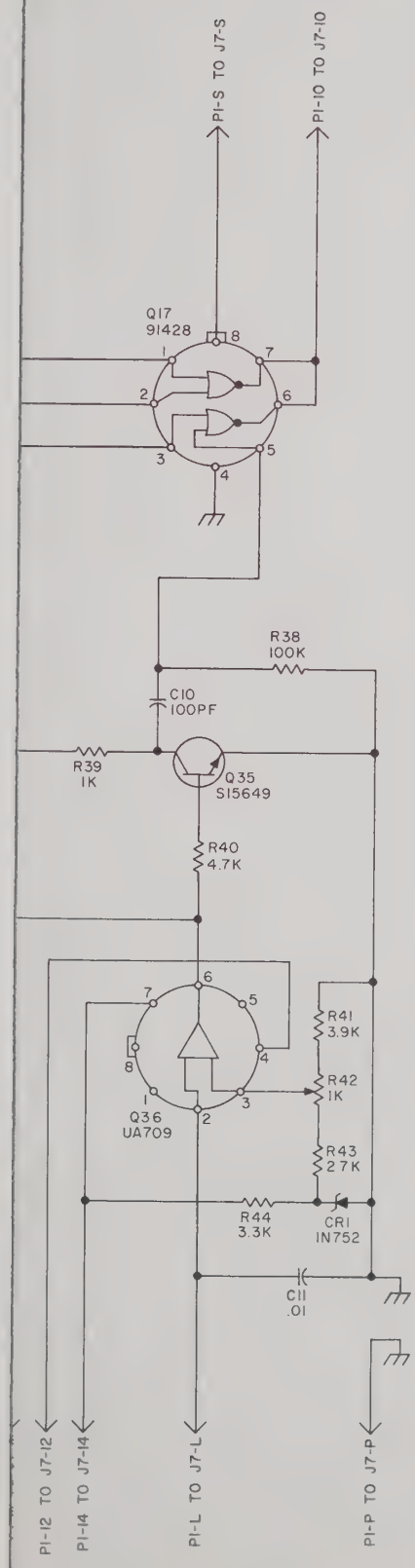


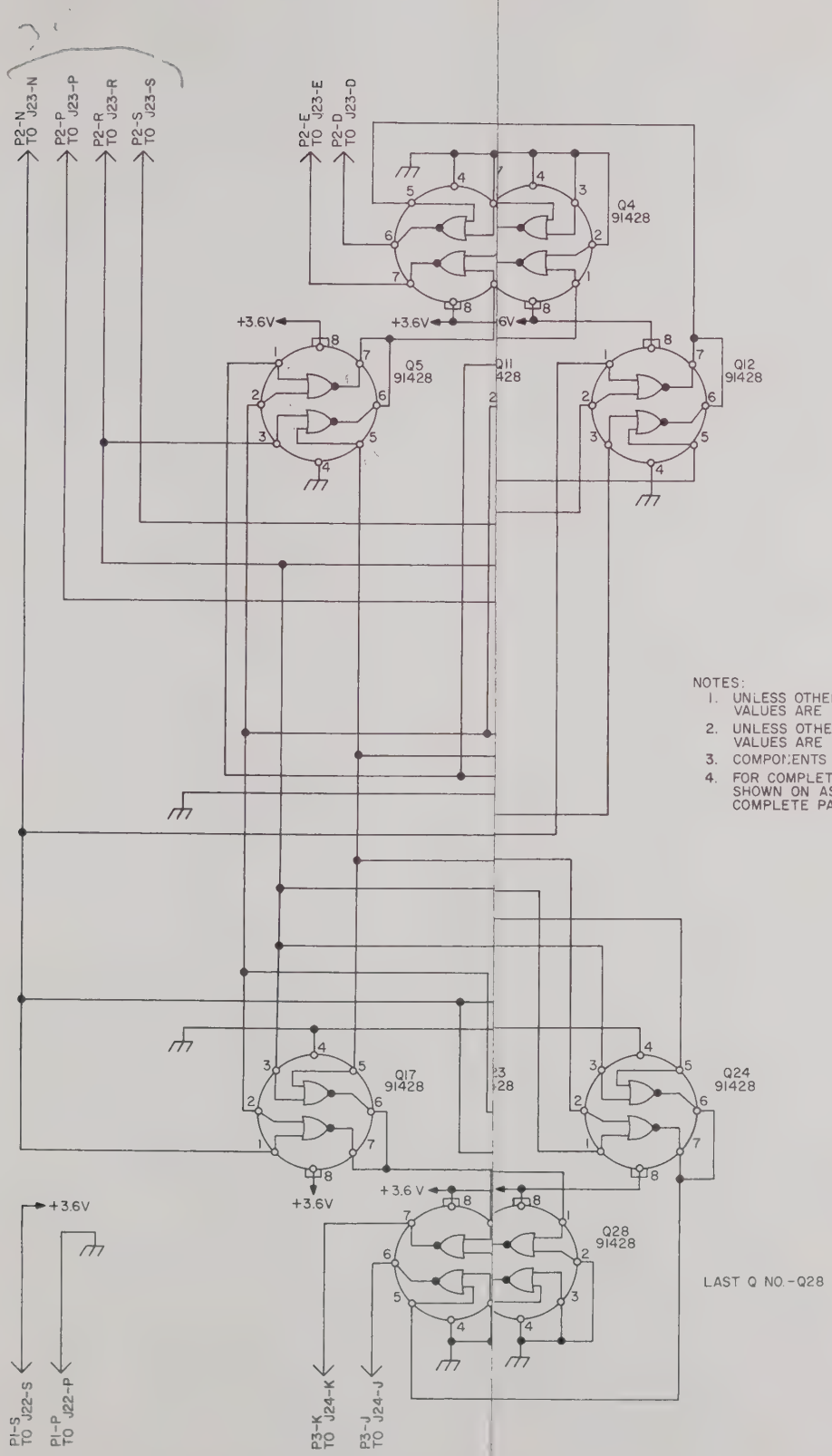
Figure 7.12 Antenna Switching Unit (A12)



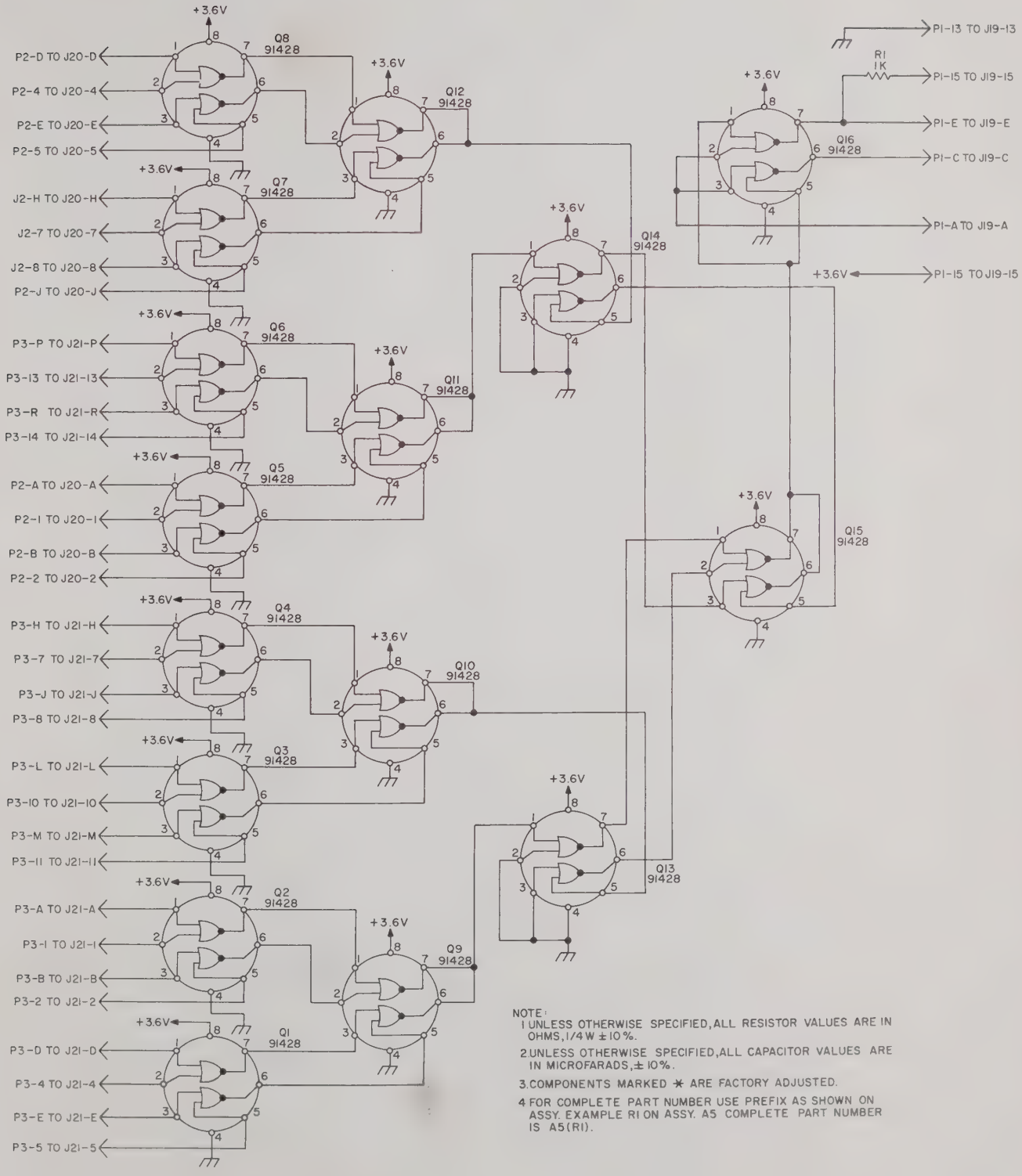
NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS, 1/4 W, ± 10%.
2. UNLESS OTHERWISE SPECIFIED, ALL CAPACITOR VALUES ARE IN MICROFARADS, ± 20%
3. COMPONENTS MARKED * ARE FACTORY ADJUSTED
4. FOR COMPLETE PART NUMBER USE PREFIX AS SHOWN ON ASSY EXAMPLE R12 ON ASSY A3 COMPLETE PART NUMBER IS A3 (R12)

e 7.3 State Detect Board (A3)

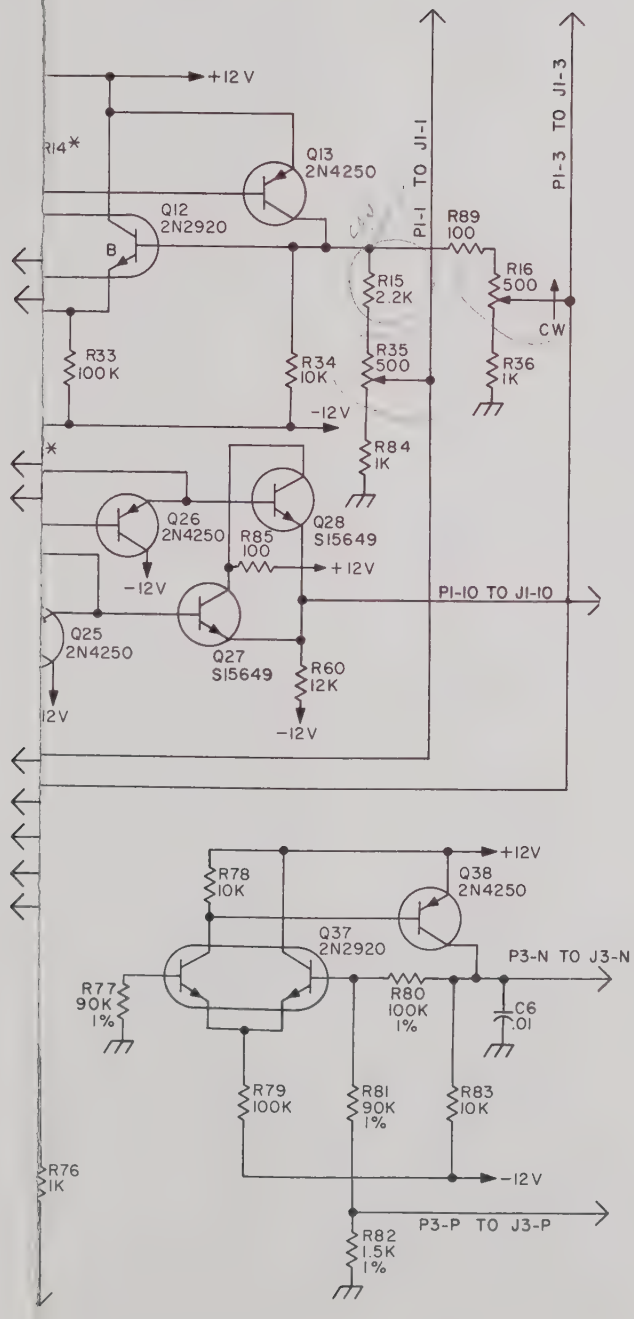

P2-N TO J23-N
P2-P TO J23-P
P2-R TO J23-R
P2-S TO J23-S
P2-E TO J23-E
P2-D TO J23-D
Q4 91428
Q5 91428
Q11 91428
Q12 91428
Q17 91428
Q24 91428
Q28 91428
+3.6V
+3.6 V
P1-S TO J22-S
P1-P TO J22-P
P3-K TO J24-K
P3-J TO J24-J
NOTES:
1. UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS, 1/4W, ±10%.
2. UNLESS OTHERWISE SPECIFIED, ALL CAPACITOR VALUES ARE IN MICROFARADS, ± 10%.
3. COMPONENTS MARKED * ARE FACTORY ADJUSTED.
4. FOR COMPLETE PART NUMBER USE PREFIX AS SHOWN ON ASSY. EXAMPLE Q1 ON ASSY A4 COMPLETE PART NUMBER IS A4 (Q1).
LAST Q NO.-Q28

Band Detect Board (A4)



NOTE:
1. UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS, 1/4 W ± 10%.
2. UNLESS OTHERWISE SPECIFIED, ALL CAPACITOR VALUES ARE IN MICROFARADS, ± 10%.
3. COMPONENTS MARKED * ARE FACTORY ADJUSTED.
4. FOR COMPLETE PART NUMBER USE PREFIX AS SHOWN ON ASSY. EXAMPLE R1 ON ASSY. A5 COMPLETE PART NUMBER IS A5(R1).

Figure 7.5 Comparator Board (A5)



NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS, 1/4W, ±10%.
2. UNLESS OTHERWISE SPECIFIED, ALL CAPACITOR VALUES ARE IN MICROFARADS, ± 10%.
3. COMPONENTS MARKED * ARE FACTORY ADJUSTED.
4. FOR COMPLETE PART NUMBER USE PREFIX AS SHOWN ON ASSY. EXAMPLE R5 ON ASSY A6 COMPLETE PART NUMBER IS A6 (R5).

Figure 7.6 Sweep Board (A6)

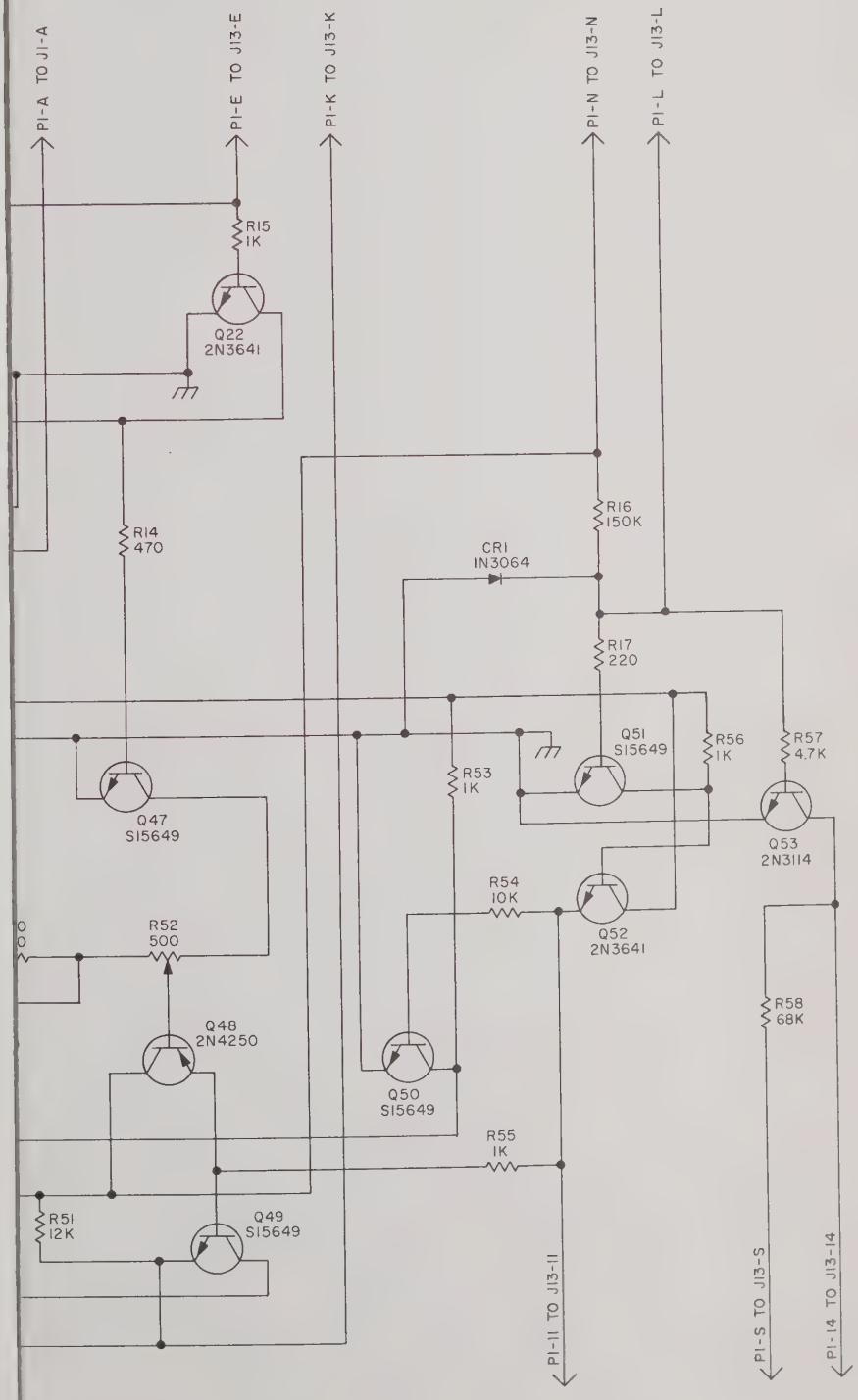
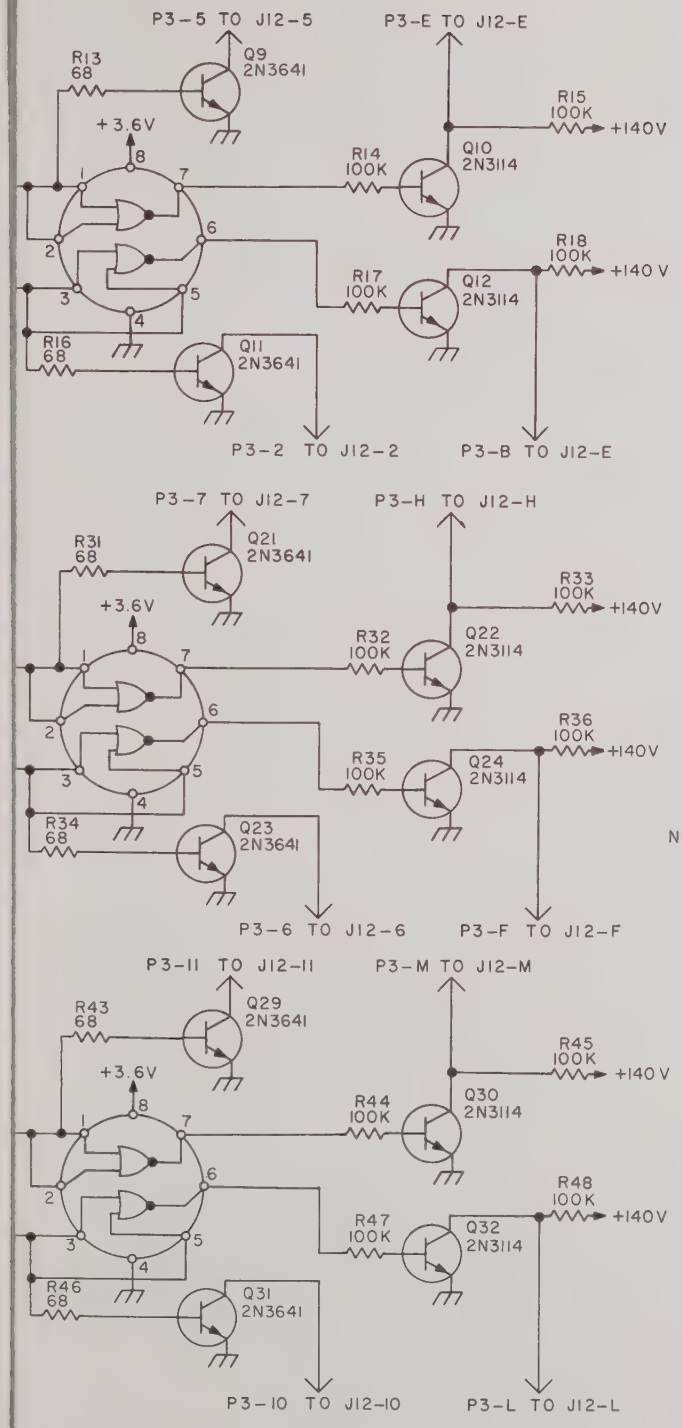


Figure 7.7 Bias Board (A7)



NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS, 1/4W, ±10%.
2. UNLESS OTHERWISE SPECIFIED, ALL CAPACITOR VALUES ARE IN MICROFARADS, ± 10%.
3. COMPONENTS MARKED * ARE FACTORY ADJUSTED.
4. FOR COMPLETE PART NUMBER USE PREFIX AS SHOWN ON ASSY. EXAMPLE R5 ON ASSY A8 COMPLETE PART NUMBER IS A8 (R5).

Figure 7.8 Signal Select Board (A8)

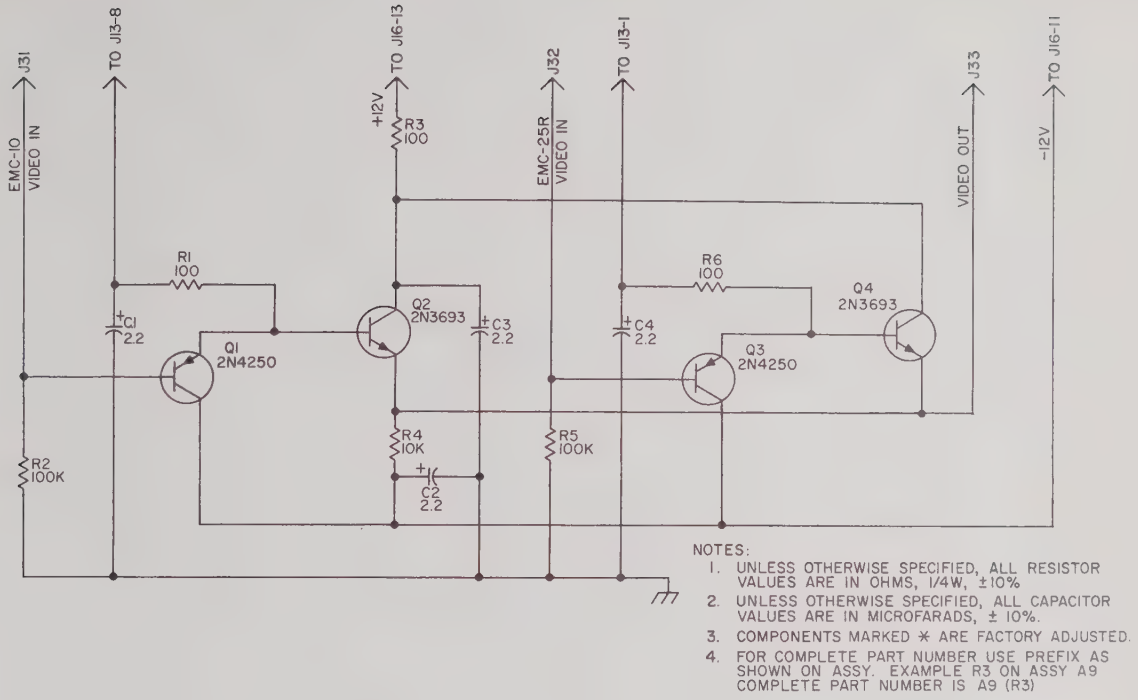


Figure 7.9 Video Select Board (A9)

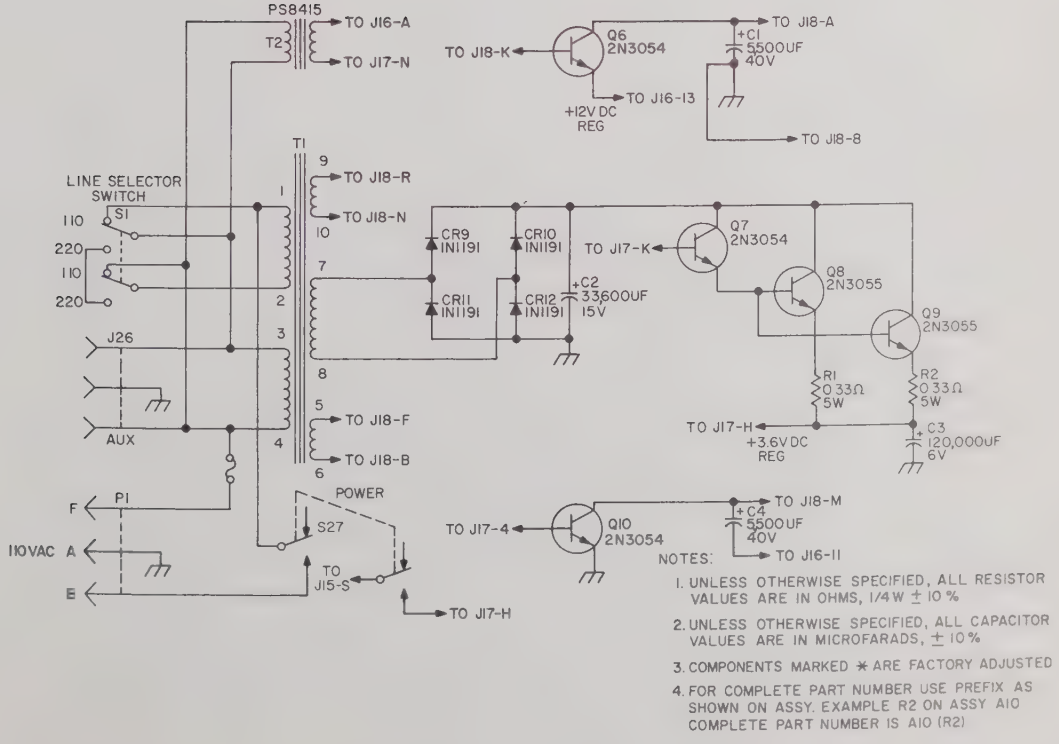
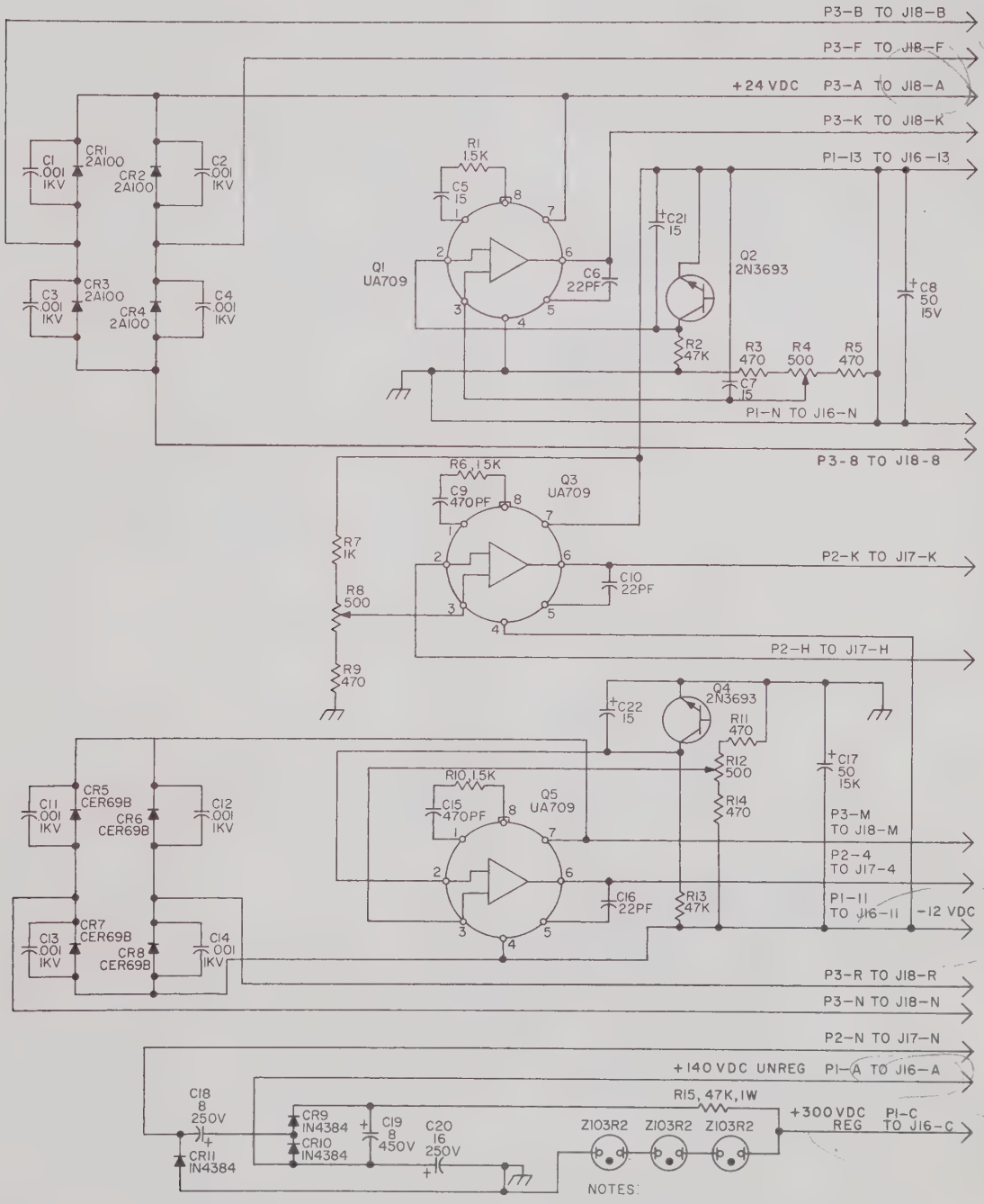


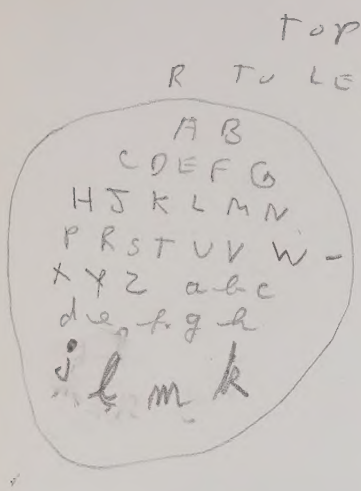
Figure 7.10 Power Supply (A10)

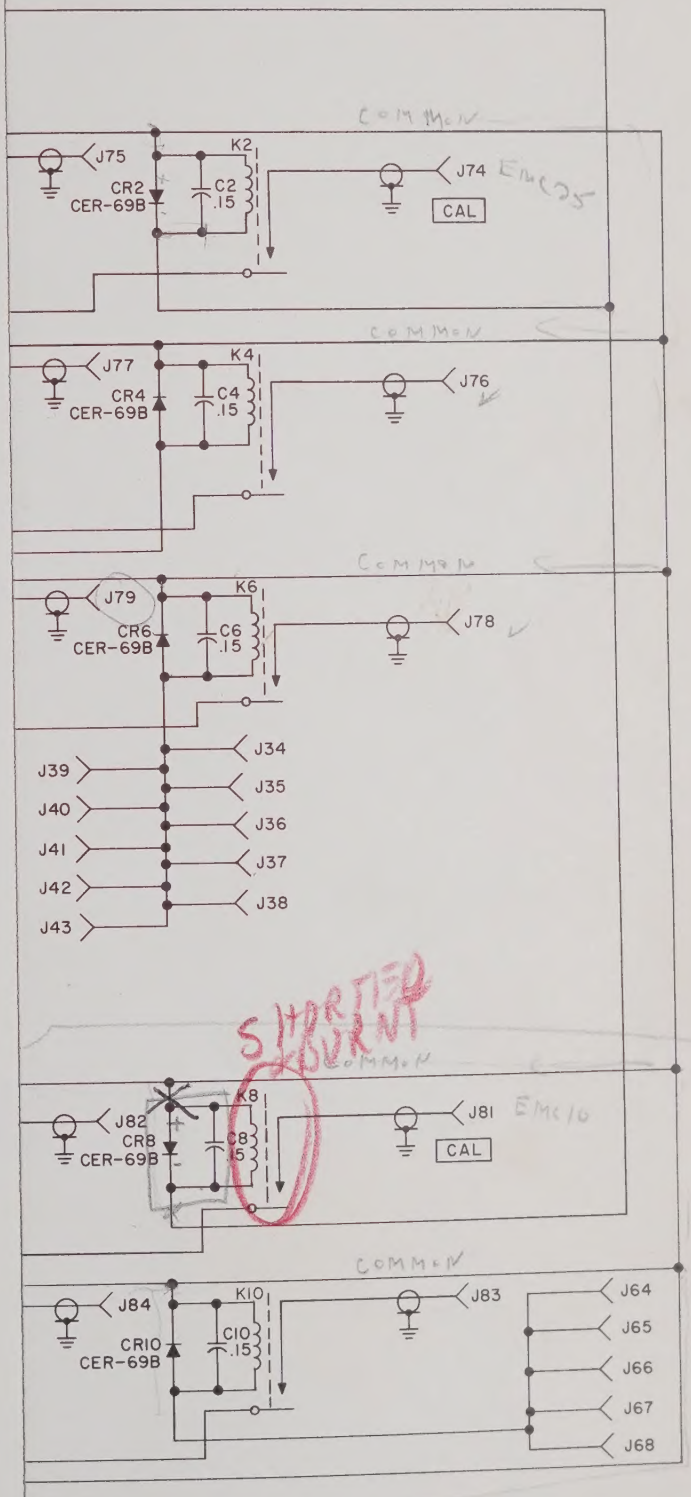


NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS, 1/4W ± 10%.
2. UNLESS OTHERWISE SPECIFIED, ALL CAPACITOR VALUES ARE IN MICROFARADS, ± 10%.
3. COMPONENTS MARKED * ARE FACTORY ADJUSTED.
4. FOR COMPLETE PART NUMBER USE PREFIX AS SHOWN ON ASSY. EXAMPLE R5 ON ASSY A11 COMPLETE PART NUMBER IS A11 (R5).

Figure 7.11 Power Supply Regulator (A11)





Antenna Switching Unit (A12)

Warranty

Electro-Metrics Corporation warrants that the articles delivered under each purchase order or contract will be free from defects in material or workmanship, under normal use and service, for a period of one year from the date of delivery to the Buyer. Electro-Metrics' obligations under this paragraph are limited, at its option, to repairing or replacing with reasonable promptness, such articles which are returned to Electro-Metrics' factory at Amsterdam, New York, transportation charges prepaid, and which, after examination are disclosed to Electro-Metrics' satisfaction to be thus defective. Semiconductors, electron tubes, fuses and batteries are excluded from liability. The provisions of this paragraph are effective only if a claim is made in writing to Electro-Metrics with the relevant information with respect to the alleged defect, within thirty (30) days following discovery of said defect.

The foregoing provisions of this warranty shall be effective only if the articles delivered under this purchase order or contract have been maintained, repaired, handled, utilized and stored in accordance with Electro-Metrics written instructions relating thereto and have not been subjected to misuse, improper installation, negligence, or accident. The provisions of this Warranty Clause are in lieu of all other warranties, expressed or implied, and of all other obligations or liabilities on Electro-Metrics' part and it neither assumes nor authorizes any other person to assume for Electro-Metrics any other liabilities in connection with the sale of the said articles. In no event shall Electro-Metrics be liable for any consequential or special damages.

Buyer_____

P.O. _____

Date_____

Vice President, General Mgr.

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